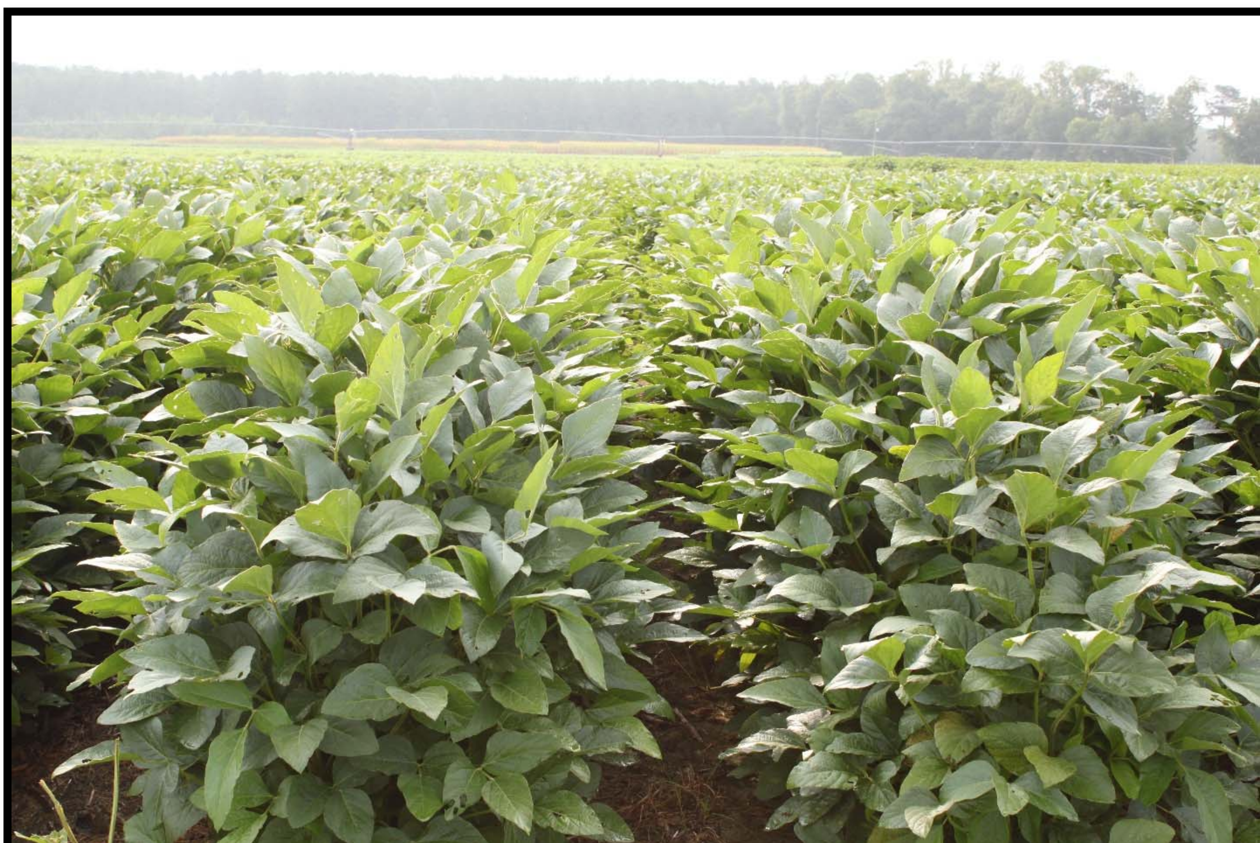
Auburn University Crops:

Soybean Research Report

2017

Research Report No. 44
Alabama Agricultural Experiment Station, 2018
Paul Patterson, Director
Auburn University
Auburn, AL



In cooperation with the Alabama Cooperative Extension System
(Alabama A&M University and Auburn University)

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Abbreviations: ACES, Alabama Cooperative Extension System; AAES, Alabama Agricultural Experiment Station; AFNR, Agriculture, Forestry, and Natural Resources.

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Acknowledgements

This publication is a joint contribution of Auburn University, the Alabama Agricultural Experiment Station, and the USDA Agricultural Research Service and National Soil Dynamics Laboratory. Research contained in AU Crops Research Reports was partially funded through the Alabama Soybean Producers, the Alabama Cotton Commission, the Alabama Wheat and Feed Grains Producers, and private industry grants. All funding is appreciated.

Confidential Report

Contents

I. Cultural Management

Variable Rate Irrigation Based on Soil Sampling and Sensor Techniques

T. Knappenberger, J. Howe, J. Shaw, D. Monks, and G. Pate

Introduction

Over the past several years, agriculture techniques have been developed that allow more precise lime, fertilizer, and pesticide application. Techniques for adapting crop-seeding rates to yield goals are now possible and will become more valuable as the technology advances. Drones allow public and private crop advisors to observe the crop from a completely different viewpoint. As this technology develops and research data sets are more complete, real-time in-season management will become more advanced as well.

The Alabama Agricultural Experiment Station has made a large investment in the past 3 years in variable rate irrigation (VRI). Within the next year, VRI will be possible at the TVREC in Belle Mina, SMREC in Crossville, GCREC in Fairhope, and WGREC in Headland. Currently, field scale, variable rate center pivot irrigation is being utilized at the EVSRC in Shorter, AL. Greg Pate, EVSRC director, has been working with Dr. Ortiz, Dr. Hagan, and others to conduct research that will make full use of this new technology.

Our objective in 2016 was to assess the yield response of eight cultivars on irrigation depth.

Materials and Methods

The cultivars Asgrow 5831 R, Pioneer 52T50 R, Pioneer 54T94 R, Asgrow 5533 R, Pioneer 55T81 R, Pioneer 56T12 S, Pioneer 56T29 R2, Pioneer 95Y70 R were evaluated for yield response on different irrigation depths. Treatments included dryland (no irrigation), 0.375", 0.75", 1.125", and 1.5". Soy beans were irrigated on:

- 6/3/16 - 0.5" across everything to encourage stand establishment
- 6/24/16 - 0.75" Treatments applied for first time.
- 7/11/16 - 1.5" Treatments applied
- 7/18/16 - 1.5" Treatments applied and then immediately received greater

than 1" rainfall

- 7/26/16 - 1.5" Treatments applied
- 7/30/16 - 1.5" Treatments applied
- 8/27/16 - 1.5" Treatments applied

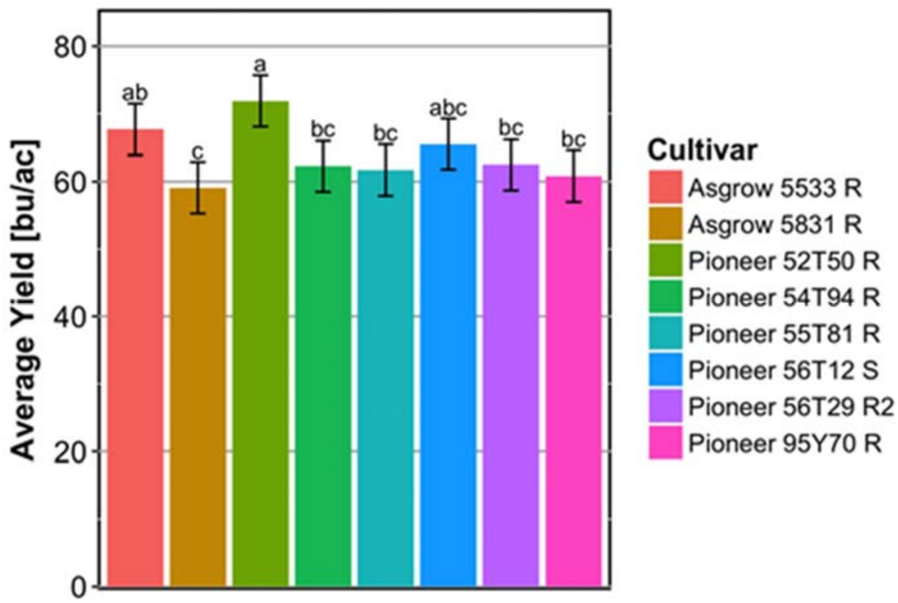


Figure1: The research field on the Dee River Ranch

All cultivars were planted at 150,000 seed per acre. Crop management: Burndown with Gramoxone Inteon (1qt/a); Layby Roundup PowerMax (1qt/a).

Results

The cultivar with the highest yield was Pioneer 52T50 R followed by Asgrow 5530 R. Both cultivars yielded significantly higher than the other tested cultivars (Figure 1). The performance of each cultivar per irrigation treatment is shown in Figure 2. Figure 3 shows a ranking of the eight cultivars per irrigation treatment. For all treatments, Pioneer 52T50 R outperformed the other cultivars. We also want to point out how Pioneer 52T94 R ranked: in the dryland treatment it was ranked second last and with increase of irrigation depth the performance of Pioneer 52T94 R increased. At last, it ranked second in the treatment with the highest irrigation depth.

Future Research

We will continue to evaluate the performance of cultivars under irrigation treatments. For 2017, we plan to implement irrigation strategies that include irrigation timing and irrigation depth. We will evaluate the check book method, sensor based irrigation (watermarks), and irrigation based on growth stage.

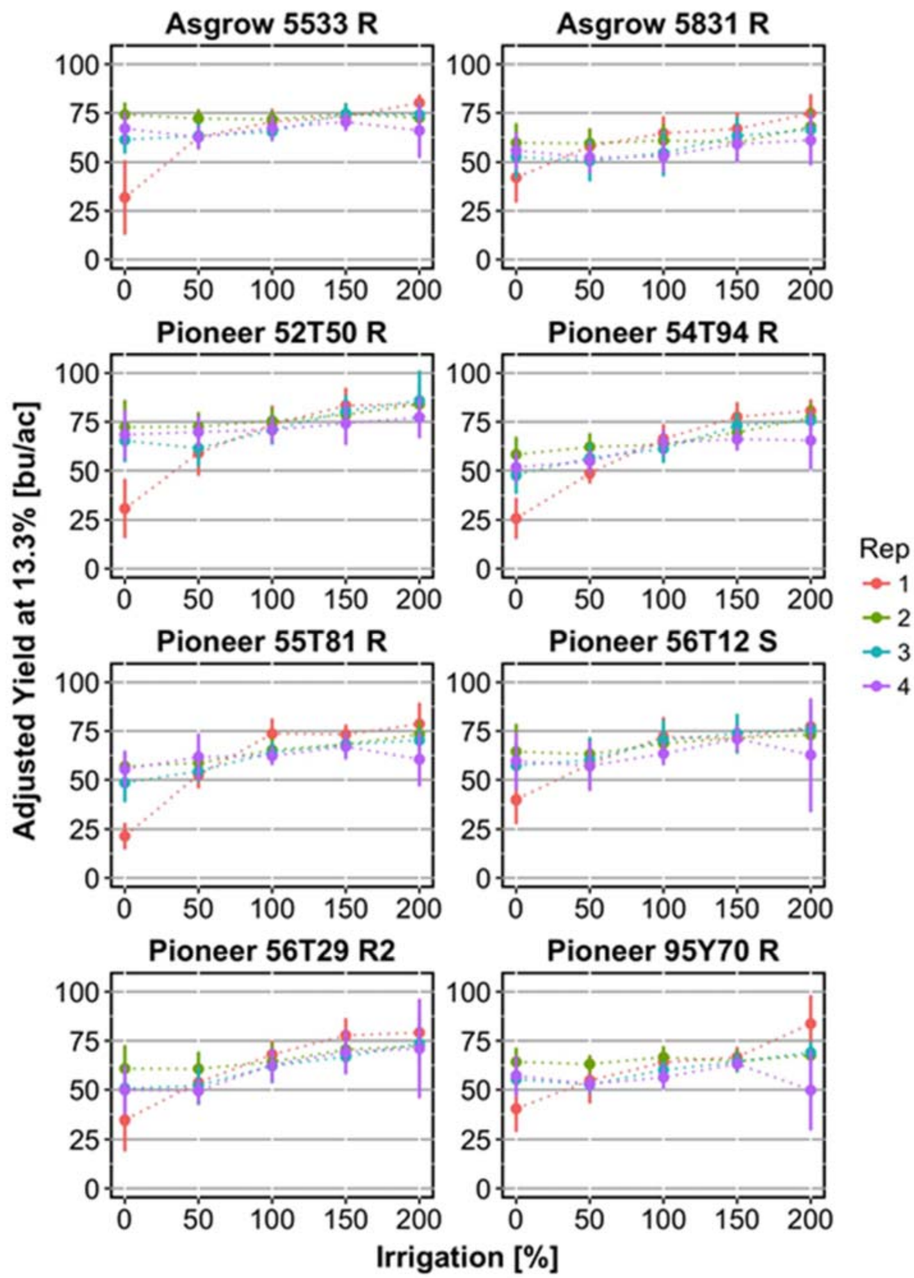


Figure 2: The research field on the Dee River Ranch.

	Irrigation [%]				
Rank	0%	50%	100%	150%	200%
1	Pioneer 52T50 R	Pioneer 52T50 R	Pioneer 52T50 R	Pioneer 52T50 R	Pioneer 52T50 R
2	Asgrow 5533 R	Asgrow 5533 R	Asgrow 5533 R	Asgrow 5533 R	Pioneer 54T94 R
3	Pioneer 56T12 S	Pioneer 56T12 S	Pioneer 56T12 S	Pioneer 56T12 S	Pioneer 56T29 R2
4	Pioneer 95Y70 R	Pioneer 55T81 R	Pioneer 55T81 R	Pioneer 54T94 R	Asgrow 5533 R
5	Asgrow 5831 R	Pioneer 95Y70 R	Pioneer 56T29 R2	Pioneer 56T29 R2	Pioneer 56T12 S
6	Pioneer 56T29 R2	Pioneer 54T94 R	Pioneer 54T94 R	Pioneer 55T81 R	Pioneer 55T81 R
7	Pioneer 54T94 R	Asgrow 5831 R	Pioneer 95Y70 R	Pioneer 95Y70 R	Pioneer 95Y70 R
8	Pioneer 55T81 R	Pioneer 56T29 R2	Asgrow 5831 R	Asgrow 5831 R	Asgrow 5831 R

Figure 3: The research field on the Dee River Ranch.

Improvement of Irrigation Management on Alabama Black Belt Soils

T. Knappenberger, B. Ortiz, D. Delaney, J. Shaw, and A. Dee

Introduction

Several soybean growers in Alabama's Black Belt Region have installed central pivot irrigation systems in recent years. However, soybean yield response on these heavy textured soils is oftentimes smaller than anticipated. To improve irrigation and soil water management, it is necessary to investigate the yield limiting factors.

Material & Methods

On-farm research was carried out on the Dee River Ranch in Aliceville, Alabama. This location was chosen for its unique combination of irrigation and tile drainage. The research field has two irrigation pivots and part of the field is tile-drained (Figure 1) resulting in four treatments: dryland, dryland & tile-drained, irrigated, and irrigated & tile-drained.

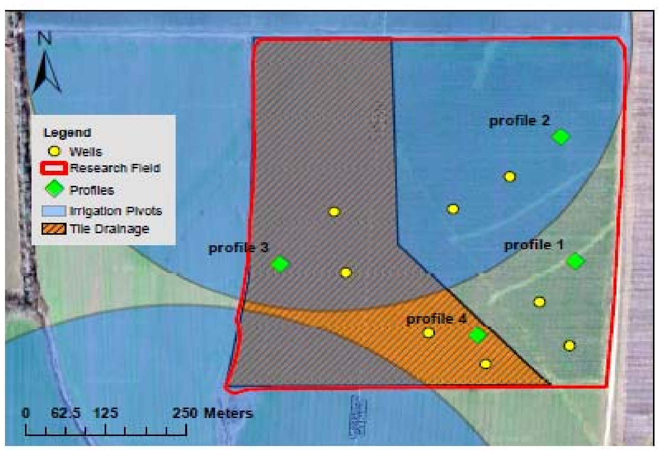


Figure 1: The research field on the Dee River Ranch.

Data loggers were installed to measure soil water content (depths of 15, 30, and 60 cm), matric potential (15 cm), and groundwater level on four locations, one for each treatment. The data loggers and the sensors were installed after planting in May 2016 and were removed before harvest at the beginning of September 2016. Additionally, we installed 8 groundwater wells as shown in Figure 1.

Root growth was monitored at 20 profiles, 5 in each treatment. At each profile, several images from the root zone were taken and later analyzed in the lab for roots.

Yield was measured with a commercial combine yield monitor. Because the four treatment areas "dryland", "dryland & tile-drained", "irrigated", and "irrigated & tile-drained", were different in size, we needed to create a yield data set with equal observations per treatment. Between treatments was a 120 feet buffer where yield was not assessed to avoid blending effects.

Results

Figure 2 shows rainfall and irrigation data for the study time period. Rainfall occurred frequently every week to every second week. Rainfall was 240 L/m^2 (9.4 inches) between May 19th and September 1st. In that time period, the research field was irrigated four times with amounts between 19 and 25 L/m^2 (0.75-1 inches) resulting in an overall irrigation volume of 89 L/m^2 (3.5 inches).

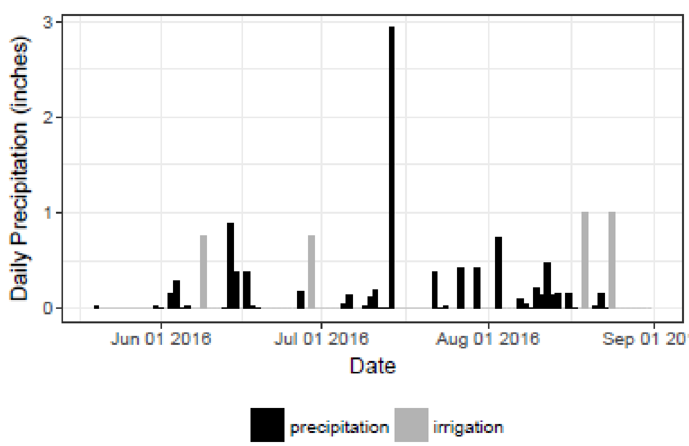


Figure 2: Rainfall and irrigation pattern over the research time period.

Figure 3 shows the matric potential of the four locations in a depth of 15 cm (6 inches). The black horizontal line is at a matric potential of -50 kPa. Plants are considered to suffer water stress at matric potentials below -50 kPa which is why this value is considered as a irrigation trigger. Irrigated treatments have higher matric potentials with values above -50 kPa for most of the research period (Figure 3). Dryland treatments have lower matric potentials and plants in the dryland may have suffered more water stress than plants under irrigation.

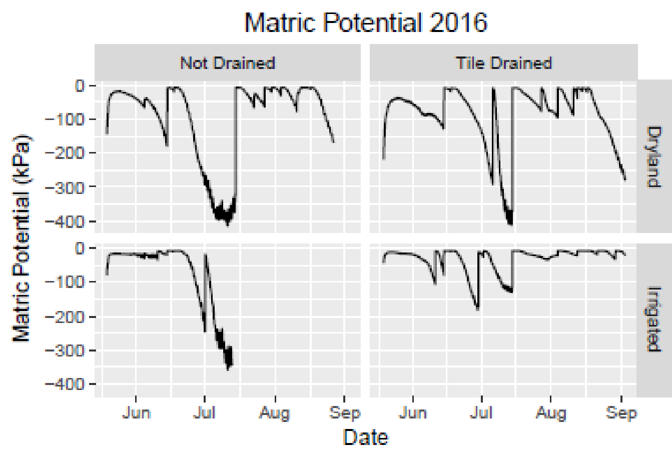


Figure 3: Matric potential at the four treatment locations in a depth of 15 cm (6 inches).

With lower matric potentials in the dryland the volumetric water content was consequently also lower in the dryland in a depth of 15 cm (6 inches). Figure 4 shows the volumetric water content for depths of 15, 30, and 60 cm (6, 12, and 24 inches). The water content of dryland and irrigated land differ in depths of 15 and 30 cm (6 and 12 inches) with the most distinct differences in 30 cm depth (12 inches). The water content in 60 cm (24 inches) does not seem to be affected by irrigation as all values are at about the same magnitude.

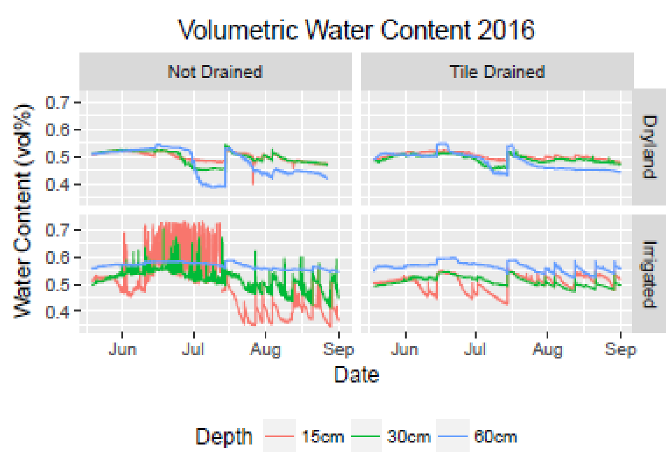


Figure 4: Volumetric water content in depths of 15, 30, and 60 cm (6, 12, and 24 inches).

The groundwater table well depths were 6 feet in all treatments. Based on the results from 2015 we have dug the wells deeper. Figure 5 shows the groundwater levels over the research time period.

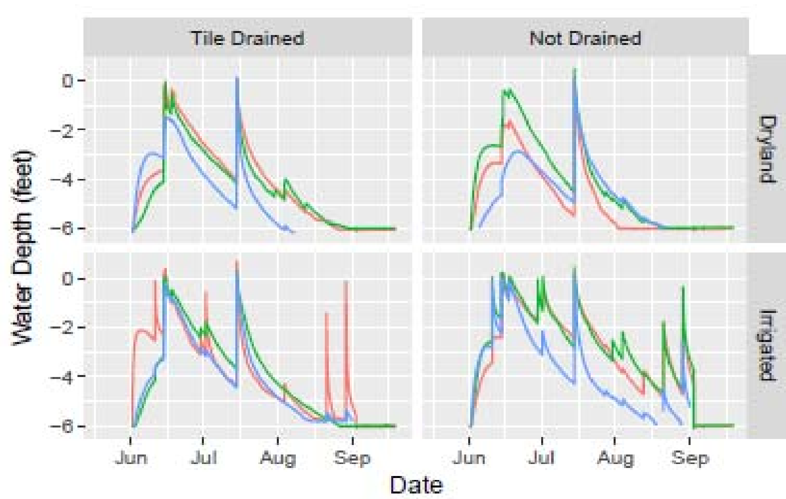


Figure 5: Groundwater levels at each monitor location.

Yield was measured with a commercial combine yield monitor. Figure 6 shows the average yield per treatment and year. In 2016, the "dryland" treatment had the lowest yield (63 bu/acre) followed by "irrigated" (69), "dryland & tile-drained" (72), and "irrigated & tile-drained" (76). Interestingly, the "dryland & tile-drained" treatment resulted in a higher yield than the "irrigated" treatment.

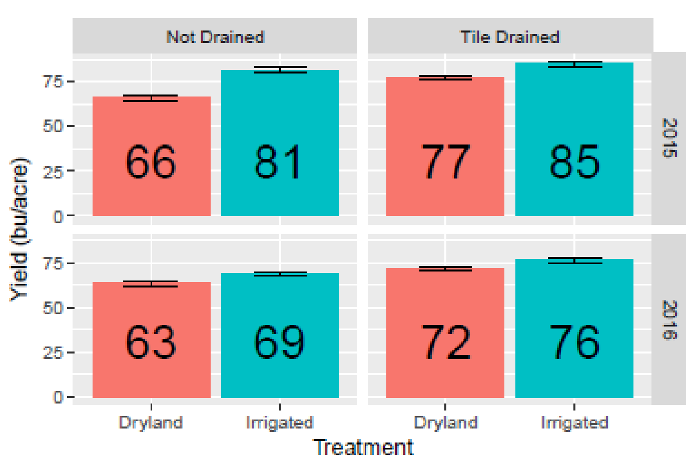


Figure 6: The average yield for 2015 and 2016. Numbers are in bushels/acre.

Root analysis per depth increment is shown in Figure 7. We hypothesized that tile drainage increases rooting depth. The root volumes in the lowest image window in 24-

32" depth were: “dryland” (7.4), “dryland & tile-drained” (13.7), “irrigated” (12.1), and “irrigated & tile-drained” (12.1). Both, drainage and irrigation increased rooting depth.

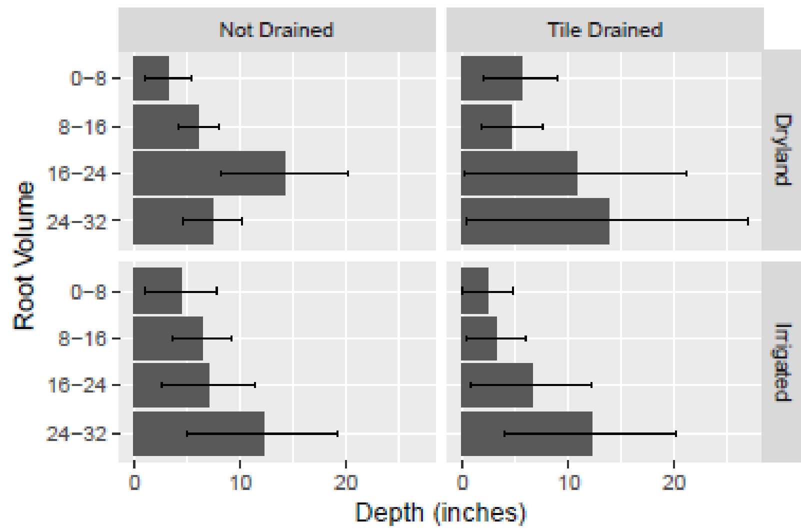


Figure 7: Average root volumes per image depth increment.

Discussion

The results show that tile-drainage and irrigation both increased the yield. The research field was irrigated and irrigation showed clear effects on matric potential (Figure 3) and yield (Figure 6). The 2016 drought was probably too late in the growing season to affect the yield in the dryland treatments. This study needs to continue to be able to make stronger conclusions about the effects of irrigation and tile-drainage on Blackbelt soils. The rooting depth was considered as a yield limiting factor and the water table was expected to be very shallow limiting the rooting depth. However, the data from our monitoring wells (Figure 5) indicate deeper groundwater levels than expected, at least for the later growing season. Other than groundwater rooting depth is also affected by the gas exchange capacity of a soil as roots need oxygen. Heavy and fine textured soils like the Blackbelt soils have low gas exchange capacities.

Future Research

- Similar experiments should continue on this location because of its unique combination of irrigation and tile-drainage allowing to study effects of both within immediate vicinity.

- Corn will be grown on this field in 2017 and we will continue with this research in corn at the same location.

Row Spacing and Population Density Effect on Soybean Seed Yield

T. Sandlin, D. Delaney, and M. Hall

One on-farm soybean row spacing and seeding rate trial was conducted in 2016. Early season drought and reduced full-season soybean acres did not lend itself to early planted trials. Therefore, this test was double cropped behind wheat. This test was located on farm in Limestone County (Elkmont, AL). The test was planted June 25, 2016 with Asgrow 5831 RR2 soybeans and harvested on October 19, 2016. The test contained one large strip for each treatment 37.5 feet in width and row length 440 feet. Yields were as follows for each treatment:

(1) 15” row x 120,000 seeding rate [50.5 bu/A]

(2) 15” row x 140,000 [55.0 bu/A]

(3) 15” row x 160,000 seeding rate [54.2 bu/A]

(4) 30” row x 120,000 seeding rate [51.2 bu/A]

(5) 30” row x 140,000 seeding rate [53.8 bu/A]

(6) 30” row x 160,000 seeding rate [53.6 bu/A]

Two year average yields for 3 locations averaged together are as follow for each treatment

(1) 15” row x 120,000 seeding rate [49 bu/A]

(2) 15” row x 140,000 [50.9 bu/A]

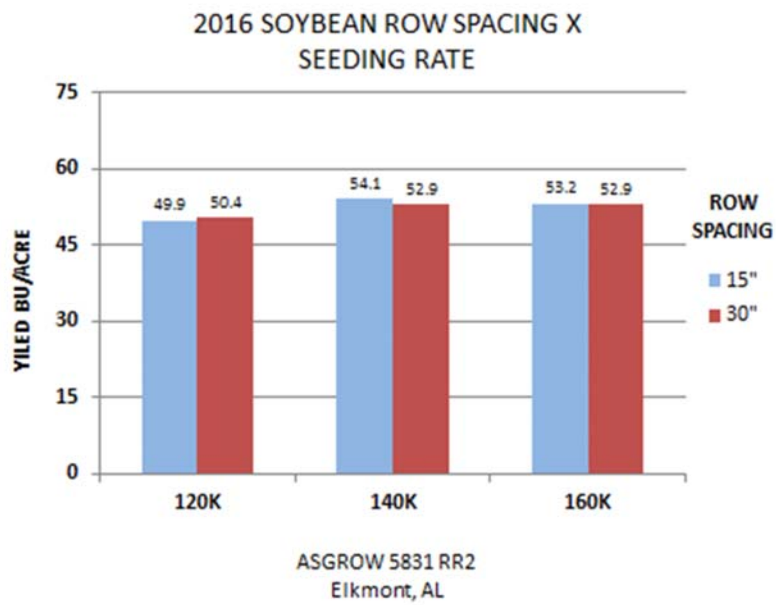
(3) 15” row x 160,000 seeding rate [51.0 bu/A]

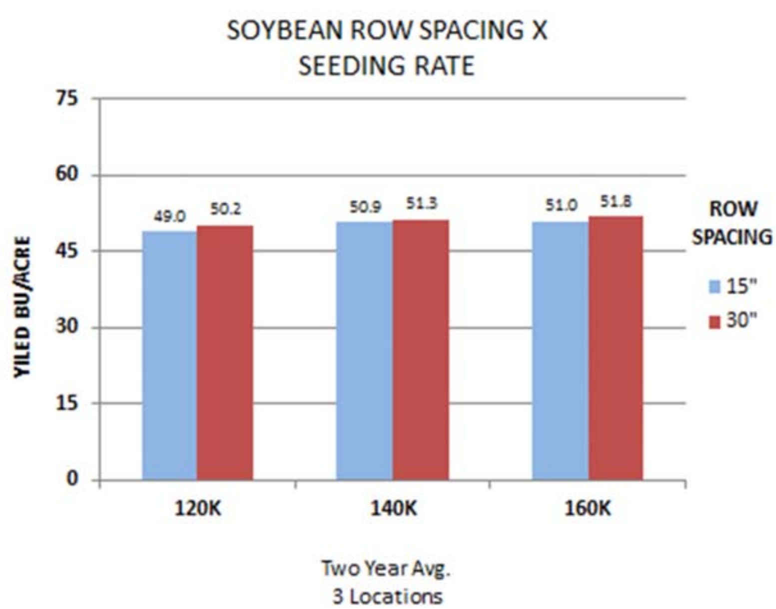
(4) 30” row x 120,000 seeding rate [50.2 bu/A]

(5) 30” row x 140,000 seeding rate [51.3 bu/A]

(6) 30” row x 160,000 seeding rate [51.8 bu/A]

No significant differences were seen with respect to soybean yield for this test. Soybean seeding rates of 140,000 and 160,000 proved to yield slightly greater numerically for both row spacings. Weed control was monitored with little to no differences observed for any treatment. Consideration should be given to variety and potential for resistant weed populations when choosing soybean row spacing.


2016 SOYBEAN ROW SPACING X
SEEDING RATE
YILED BU/ACRE
75
60
45
30
15
0
49.9
50.4
54.1
52.9
53.2
52.9
120K
140K
160K
ROW SPACING
15"
30"
ASGROW 5831 RR2
Elkmont, AL


SOYBEAN ROW SPACING X
SEEDING RATE
YILED BU/ACRE
75
60
45
30
15
0
49.0
50.2
50.9
51.3
51.0
51.8
120K
140K
160K
ROW SPACING
15"
30"
Two Year Avg.
3 Locations

Soybean Improvement and Germplasm Enhancement

J. C. Koebernick

In August of 2016, Dr. David Weaver retired and Jenny Koebernick stepped into his role, taking over current research/field projects. The primary project is to utilize the oil-producing capacity of Henderson, a Maturity Group VIII cultivar, known for high yield and oil, to produce a non-GMO high oleic acid soybean oil. In 2014, Henderson and S13-16219 (a source of the high oleic acid trait licensed to us by USDA and the University of Missouri) were successfully crossed and 22 F_1 hybrid seed were obtained. An additional cross that was made was G10PR-2242R (elite experimental line from the University of Georgia) × S13-16188 (a line similar to S13-16219 and also having the high oleic acid trait). In 2016, the F_2 seed were advanced under irrigation to produce the F_3 generation. These seed will be analyzed for the high oleic trait. This combination of a high oil production genotype coupled with the positive influence of high temperatures during the growing season will make this a very attractive package for producers interested in the high-oleic specialty market.

Our main research effort continues to focus on participation in the USDA Uniform Cooperative Tests, growing 12 tests in 3 locations (Tallassee, Belle Mina, and Fairhope) and evaluating over 230 elite public breeding lines of Maturity Groups V, VI, VII and VIII in both Preliminary and Uniform Tests. This continues to be a major resource of genetic material, as well as a great testing network for evaluation of new genotypes from all public breeding programs in the Southeast. Without these tests, there would be no evaluation of elite public germplasm in Alabama. These lines not only are subject to release by the public developers, they also serve as a major source of germplasm for use by industry in development of high-yielding, good agronomic cultivars with transgenic traits for the production market. However, extensive resources, in terms of labor and materials, are required to conduct these tests. We receive no money from USDA. One additional aspect this year was that breeders across the southeast report very poor seed quality in their breeding programs due to extensive rainfall during harvest. The Belle Mina location produced seed of reasonable quality, and we are being looked upon as a seed supplier for many of these programs.

II. Fertilizer Management

Improve Plant Health with Starter Fertilizers and Added Plant Hormones to Boost Soybean Yield Potential

K. S. Lawrence, E. Sikora, D. Delaney, and D. Dodge

Justification

Starter fertilizers and added plant hormones are being marketed as increasing soybean root growth. Do these additives increase plant health adequately to eliminate the stress and yield loss of reniform or root-knot nematodes?

Objectives

1. Evaluate commercially available plant hormones for best rate and application timing for producing biomass in the presence of root-knot or reniform nematodes;

2. Evaluate starter fertilizers for optimum growth of soybean in the presence of each nematode;

3. Evaluate new nematicides for the best efficacy; and

4. Apply best plant hormone, starter fertilizer and nematicide combinations into microplot and field trials for soybean growing season 2017.

Materials and Methods

Greenhouse trials: 1. Plant hormones including Indole Butryic Acid, Gibberellic Acid, and Cytokinin sold as the product Ascend™ were evaluated as a seed treatment, in-furrow spray, and a foliar spray to determine the effects on soybean plant growth in the presence of reniform or root-knot nematodes. 2. A second set of tests will evaluate starter fertilizers Neptune's Harvest, Sure-K, Pro-Germ, and Micro-500 were applied in varying combinations to determine the effects on soybean plant growth in the presence of our nematodes. 3. Third a set of nematicide studies will evaluate the efficacy of the new and standard nematicides. All these tests will be conducted in the greenhouse. Soybean growth will be tested in 150 cc conetainers inoculated with 2000 reniform or root-knot eggs and allowed to grow in the greenhouse for 45 days before harvest. Data from greenhouse tests will determine the best plant hormone applications, starter fertilizer combinations, and effective nematicide.

Microplot and Field trials: The best plant hormone applications, starter fertilizer combinations, and nematicide will be tested in the microplots and in the field. Microplots are located at the PSRC and are artificially infested with reniform or root knot nematodes. The field trials will be located at the TVREC in northern Alabama and at the PBU or Prattville in central Alabama. Plant growth parameters, nematode populations, and yield will be collected from the microplot and field trials.

Outcome

Identify the best combination of starter fertilizers, plant hormones and nematicides to enhance soybean yield in the presence of the root-knot nematode.

Amount requested

Total costs that will be $10,000

1. Salaries
2. Wages
3. Graduate student (1/2) time - $7,500
    i. Benefits - $135
4. Operating
    a. Travel - $2,365
        i. Trips to the TVREC and PBU cost $500 in mileage and meals each and we expect to monitor the fields monthly during the season.

Results:

Greenhouse Plant Growth Regulator Trials

Ascend plant growth regulator treatments did not significantly increase plant biomass, plant height, root and shoot fresh weights over the control at 45 days after planting (DAP) (Table 1). The in-furrow spray treatment was 13% greater in biomass than the control; the in-furrow spray with an added foliar spray was 16% greater in biomass than the control. The in-furrow spray treatment significantly increased total *Meloidogyne incognita* eggs over the control; all Ascend treatments did not significantly increase *Meloidogyne incognita* eggs per gram of root compared to the control. The in-furrow spray was selected as a simple, yet effective treatment to be utilized in field trials.

Table 1. Plant growth regulator effects on average soybean root and shoot fresh weight, plant biomass, *Meloidogyne incognita* total egg numbers, and eggs per gram of root at 45 DAP in greenhouse trials.

					Meloidogyne incognita	
Treatment	Rate	Root fresh weight (g)	Shoot fresh weight (g)	Plant biomass (g)	Total eggs	Eggs/g root
Control [z]	---	6.17 [y]	7.80	13.98	30282	2642
Ascend™ST	88.7 mL/cwt	5.98	7.90	13.88	48993	3594
Ascend™IFS	233.7 mL/ha	7.34	8.48	15.82	753079*	2122
Ascend™FS	292.2 mL/ha	5.28	7.27	12.55	42078	2839
Ascend™ST+ IFS	233.7mL/ha +292.2 mL/ha	6.60	7.52	14.12	641607	3341
Ascend™ST+ FS	88.7 mL/cwt + 292.2 mL/ha	6.23	7.96	14.20	39134	2174
Ascend™IFS + FS	233.7 mL/ha +88.7mL/cwt	7.66	8.50	16.17	58203	2877
Ascend™ST+ IFS + FS	88.7 mL/cwt + 233.7 mL/ha + 292.2mL/ha	5.78	7.42	13.21	50096	4805

[z]Ascend™ is comprised of cytokinin 0.090%, gibberellic acid 0.03%, indole butyric acid 0.045%. Ascend™ ST is a seed treatment, Ascend™ IFS is an in-furrow spray, Ascend™ FS is a foliar spray applied at 2 true leaf stage. [y]Means in the same column followed by * $P \leq 0.10$; ** $P \leq 0.05$ according to Dunnett's P values compared to the control are ssignificantly different.

Starter Fertilizer Greenhouse Trials

Pro-Germinator, Sure-K, Micro-500, Neptune's Harvest, Pro-Germinator plus Micro-500, and Neptune's Harvest plus Micro-500 significantly increased shoot fresh weight over the control at 45 DAP. Neptune's Harvest, Micro-500, Pro-Germinator, and Pro-Germinator plus Micro-500 significantly increased plant biomass compared to the control. Starter fertilizers had no significant effect on *M. incognita* eggs at 45DAP; *M. incognita* eggs per gram of root were not significantly different among treatments. Sure-K+Micro-500 increased plant biomass over the control by 10%. The combination treatment: Sure-K+ Micro-500 was selected to be used in field trials due to viscosity concerns with Neptune's Harvest and reduced germination rates associated with Pro-Germinator.

Table 2 A. Starter fertilizer effects on average soybean root and shoot fresh weight, plant biomass, *Meloidogyne incognita* total egg numbers, and eggs per gram of root at 45 DAP in greenhouse trials.

					Meloidogyne incognita	
Treatment	Rate	Root fresh weight (g)	Shoot fresh weight (g)	Plant biomass (g)	Total eggs	Eggs/g root
Control	---	3.29 [y]	4.42	7.71	4637	1404
Sure-K™ [z]	9.28 L/ha	4.01	5.37*	9.39	5755	1505
Pro-Germinator™	4.64 L/ ha	3.91	6.44**	10.36**	5932	1505
Micro 500™	2.32 L/ ha	3.58	6.04**	9.63*	3787	1098
Neptune's Harvest™	7.41 L/ ha	3.81	5.79**	9.60*	6434	2307
Sure-K™ + Micro 500™	9.28 L/ ha + 2.32 L/ha	3.51	4.92	8.44	6728	1717
Pro-Germinator™ + Micro 500™	4.64 L/ ha + 2.32 L/ha	4.31	6.17**	10.48**	3634	848
Neptune's Harvest™ + Micro 500™	7.41 L/ ha + 2.32 L/ha	3.57	5.53**	9.09	4078	1147

[z]Fertilizers selected in these trials were Sure-K™ (2-1-6), Pro-germinator™ (9-24-3), Micro 500™ (B 0.02%, Cu 0.25%, Fe 0.37%, Mn 1.2%, and Zn 1.8%), and Neptune's Harvest (2-4-1).

[y] Means in the same column followed by * $P \leq 0.10$; ** $P \leq 0.05$ according to Dunnett's P values compared to the

Nematicide Greenhouse Trials

Nematicide and insecticide combinations greenhouse trials showed no significant benefit to plant biomass or shoot and root fresh weights at 30 DAP. Avicta, Cruisermaxx plus Avicta, ILeVO, and Poncho/VOTiVO plus ILeVO significantly reduced nematode eggs per gram of root by 91%, 87%, 74%, and 93% on average, respectively. The Avicta and ILeVO nematicides were chosen for implementation in field trials.

Table 3. Nematicide and insecticide effects on average soybean root and shoot fresh weight, plant biomass, *Meloidogyne inconita* total egg numbers, and eggs per gram of root at 45 DAP in greenhouse trials.

					Meloidogyne incognita	
Treatment	Rate	Root fresh weight (g)	Shoot fresh weight (g)	Plant biomass (g)	Total eggs	Eggs/g root
Control	---	4.67	9.44	14.11	49955	11225
Cruisermaxx	88.72 mL/CWT	3.18	7.49	10.68	21785**	8457
Avicta	0.15 mg ai/seed	3.90	7.94	11.84	2735**	1323**
Cruisermaxx+ Avicta	+0.15 mg ai/seed	5.10	9.70	14.81	6026**	1323**
Poncho/ VOTiVO	0.13 mg ai/ seed	2.45**	7.47	9.92**	36662	20114
ILeVO	0.15 mg ai/seed	3.00	7.88	10.89	5258**	1780**
Poncho/VOTiVO+ ILeVO	0.13 mg ai/seed+0.15 mg ai/seed	3.35	8.53	11.89	2433**	664**

[Z]Nematicides and fungicides selected in these trials were Cruisermaxx(1.25 g fludioxonil, 1.875 g mefenoxam, and 25 g thiamethoxam per 100 kg seed) Avicta (Abamectin), Poncho/VOTiVO (Clothiandin and *Bacillus firmus*), and ILeVO (fluopyram).

[Y] Means in the same column followed by * $P \leq 0.10$; ** $P \leq 0.05$ according to Dunnett's P values compared to the control are significantly different.

Microplot Results

Microplot data demonstrated no statistical differences between treatments in biomass, root-knot nematode eggs per gram of root or yield in grams. Low nematode pressure in microplots did not separate treatments statistically. Avicta + Ascend IFS (in-furrow spray) produced 22% more yield than the control and supported 97% less nematode eggs per gram of root.

Table 4. Combination effects of plant growth regulators, starter fertilizers, and nematicides on cotton root fresh weight, plant biomass, and *Meloidogyne incognita* eggs per gram of root at 30 DAP in microplots.

Treatment	Rate	Shoot fresh weight (g)	Plant biomass (g)	*M. incognita* eggs/g root	Yield (g)
Control[Y]	---	49.92	59.96	1044	292
ILeVO ST	0.15 mg ai/seed	51.23	60.98	92	342
AvictaST	0.15 mg ai/seed	62.71	76.79	26	320
Avicta +Sure-K +Micro-500 IFS	0.15 mg ai/seed +9.28L/ha	55.28	65.85	187	235
ILeVO+ Sure-K +Micro-500 IFS	0.15 mg ai/seed +9.28L/ha	38.83	46.38	137	246
Avicta+ Ascend IFS	0.15mg ai/seed 233.7mL/ha	55.18	69.14	25	347
ILeVO+ Ascned IFS	0.15mg ai/ seed 233.7m L/ha	57.49	70.01	22	299
Avicta+Sure-K +Micro-500 IFS +Ascend IFS	0.15mg ai/seed 9.28 L/ ha + 233.7m L/ha	50.55	61.64	17	246
ILeVO+Sure-K +Micro-500 IFS +Ascend IFS	0.15 mg ai/seed 9.28 L/ ha + 233.7 mL	48.53	59.26	124	342

[Y]Means in the same column followed by * $P \leq 0.10$; ** $P \leq 0.05$ according to Dunnett's P values compared to the control are significantly different.

Field Trial Results

PBU

Meloidogyne incognita population density at PBU was moderate to high during the growing season. Stand counts at 14 DAP were not statistically different among treatments thus the combinations of starter fertilizers, plant growth hormones and nematicides was not phytotoxic to the soybean seedlings. Root and shoot fresh weights, biomass and plant height were similar at 35 DAP. Avicta + Sure-K + Micro-500 significantly reduced *M. incognita* eggs per gram of root compared to the control at 35 DAP. Avicta + Sure-K + Micro-500+ Ascend IFS significantly increased yield over the ILeVO treatments. Tukey's mean separation demonstrated Avicta +Sure-K +Micro 500 + Ascend IFS was significantly greater in yield than ILeVO+ Sure-K+Micro-500 and ILeVO+ Sure-K+Micro-500+Ascend IFS. The combination of the plant growth regulator, starter fertilizers, and Avicta produced 7.3 bu/A or 13% more yield than the control and supported 38% less root-knot nematodes per gram of root than the control.

Table 5. Combination effects of plant growth regulators, starter fertilizers, and nematicides on cotton root fresh weight, plant biomass, and *Meloidogyne incognita* eggs per gram of root at 35 DAP and yields at PBU

Treatment	Rate	Shoot fresh weight (g)	Plant biomass (g)	*M. incognita* eggs/g root	Yield: Bushels/acre
Control[Y]	---	34.80	43.89	2408	56.5 ab
ILeVO ST	0.15 mg ai/seed	36.63	45.16	921	51.2 b
Avicta ST	0.15 mg ai/seed	38.37	47.81	1064	57.5 ab
Avicta +Sure-K +Micro-500 IFS	0.15 mg ai/seed +9.28L/ha	40.81	50.75	801*	59.9 ab
ILeVO+ Sure-K +Micro-500 IFS	0.15 mg ai/seed +9.28L/ha	39.39	48.9	861	50.3 b
Avicta+ Ascend IFS	0.15mg ai/seed 233.7mL/ha	46.03	57.03	1115	55.1 ab
ILeVO+ Ascned IFS	0.15mg ai/ seed 233.7m L/ha	33.79	42.24	1259	51.7 b
Avicta+Sure-K +Micro-500 IFS +Ascend IFS	0.15mg ai/seed 9.28 L/ ha + 233.7m L/ha	38.72	48.59	1488	64.1 a
ILeVO+Sure-K +Micro-500 IFS +Ascend IFS	0.15 mg ai/seed 9.28 L/ ha + 233.7 mL	35.92	44.63	1133	49.3 b

[Y]Means in the same column followed same letter are not significantly different by Tukey's $P \leq 0.10$

BARU

Meloidogyne incognita population density was low to moderate; average second stage juveniles per 100cc's were 21 across post-harvest soil samples. Stand counts were not significantly different at 14 DAP. No treatments were significantly greater than the control in plant biomass, shoot fresh weight, *M. incognita* eggs per gram of root, and yield. Avicta and Avicta+Surek-K+Micro-500+Ascend were significantly greater than ILeVO+ Sure-K+Micro-500 in plant biomass. Avicta and Avicta+starter fertilizer+

ascend were 38% and 21% greater in biomass than the control respectively. Avicta+Sure-K+Micro-500 was 6.7 bushels or 20% greater in yield than the control. Pearson's correlation coefficients demonstrated a significant, weak positive relationship between biomass and yield (0.34, P≤ 0.05).

Table 6. Combination effects of plant growth regulators, starter fertilizers, and nematicides on cotton root fresh weight, plant biomass, and *Meloidogyne incognita* eggs per gram of root at 38 DAP and yields at BARU

Treatment	Rate	Shoot fresh weight (g)	Plant biomass (g)	*M. incognita* eggs/g root	Yield: Bushels/acre
Control[X]	---	38.47 abc	47.05 abc	2.97 a	32.8 ab
ILeVO ST	0.15 mg ai/seed	35.26 bc	44.06 bc	2.17 a	32.9 ab
Avicta ST	0.15 mg ai/seed	52.48 a	64.91 a	0.88 a	38.1 ab
Avicta +Sure-K +Micro-500 IFS	0.15 mg ai/seed +9.28L/ha	39.47 abc	47.99 abc	36.5 a	39.5 a
ILeVO+ Sure-K +Micro-500 IFS	0.15 mg ai/seed +9.28L/ha	28.85 c	35.93 c	51.0 a	31.6 ab
Avicta+ Ascend IFS	0.15mg ai/seed 233.7mL/ha	36.79 abc	44.76 bc	30.1 a	34.1 ab
ILeVO+ Ascned IFS	0.15mg ai/ seed 233.7mL/ha	39.78 abc	49.10 abc	23.9 a	35.8 ab
Avicta+Sure-K +Micro-500 IFS +Ascend IFS	0.15mg ai/seed 9.28 L/ ha +	46.14 ab	57.12 ab	2.21 a	34.4 ab
ILeVO+Sure-K +Micro-500 IFS +Ascend IFS	0.15 mg ai/seed 9.28 L/ ha + 233.7 mL	35.00 bc	42.76 bc	2.72 a	28.8 b

[X]Treatments followed by the same letter are not significantly different by Tukey's $P \leq 0.10$

Outcome

At PBU The Avicta nematicide combined with the Sure-K+Micro-500 starter fertilizer and the Ascend plant growth regulator in-furrow spray supported lower root-knot nematode populations while increasing yield by 7.3 bu/A. This yield increase, with a commodity price of $9.50/bu, will profit approximately $29.30/A after cost of treatments.

III. Weed Management

Evaluation of Dicamba Tolerant Soybean Systems for Palmer Amaranth Control

J. Tredaway, A. Price, and D. Delaney

Treatments

Evaluation of Dicamba Tolerant Soybean Systems for Palmer Amaranth Control.

	Treatment	*Rate*	*Timing*
1	Untreated Check		
2	2,4-D Amine+Roundup	24 fl oz + 32 fl oz	PRE
2	Prefix+Roundup	32 fl oz + 32 fl oz	E POST
3	2,4-D Amine+Roundup	24 fl oz + 32 fl oz	PRE
3	Clarity+Roundup	12 fl oz + 32 fl oz	E POST
4	2,4-D Amine+Roundup	24 fl oz + 32 fl oz	PRE
4	Clarity+Roundup	12 fl oz + 32 fl oz	L POST
5	Sharpen+Zidua+Roundup+MSO	1 fl oz + 2 oz + 32 fl oz + 1% V/V	PRE
5	Outlook+Engenia+Roundup	16 fl oz + 12.8 fl oz + 32 fl oz	E POST
6	Verdict+Zidua+Roundup+MSO	7.5 fl oz + 2 oz + 32 fl oz + 1% V/V	PRE
6	Outlook+Engenia+Roundup	16 fl oz + 12.8 fl oz + 32 fl oz	E POST
7	Clarity+Roundup	12 fl oz + 32 fl oz	PRE
7	Clarity+Warrant+Roundup	12 fl oz + 48 fl oz + 32 fl oz	E POST
8	Clarity+Rowel+Roundup	12 fl oz + 2 oz + 32 fl oz	PRE
8	Clarity+Warrant+Roundup	12 fl oz + 48 fl oz + 32 fl oz	L POST
9	Verdict+Zidua+Roundup+MSO	7.5 fl oz + 2 oz + 32 fl oz + 1% V/V	PRE
9	Engenia+Roundup	12.8 fl oz + 32 fl oz	L POST
10	Sharpen+Zidua+Engenia+Roundup+MSO	1 fl oz + 2 oz + 12.8 fl oz + 32 fl oz + 1% V/V	PRE
10	Outlook+Engenia+Roundup	16 fl oz + 12.8 fl oz + 32 fl oz	E POST

Materials and methods

This study was located at the Field Crops Unit of the E.V. Smith Research and Extension Center in Shorter, AL. This trial was conducted as a randomized complete block design with 10 treatments including an untreated check and 4 replications. This trial was established as a No-Till area. Pre-plant (PRE) applications were applied on June 2, 2016, and a window of 7-14 days was needed between this application and planting due to the inclusion of 2,4-D in some of the treatments. The soybeans were planted on eleven days later on June 14, 2016. The Early Postemergence (EPOST) applications were applied on June 30, 2016, and the Late Postemergence (L POST) applications were applied on July 11, 2016. Weed control ratings were taken at planting, and a few days before the L POST application. The trial was harvested on September 28, 2016 with a harvested area of 6 x 25 ft.

Results

Weed control ratings were evaluated for % control of Palmer amaranth on a scale of 0-100%. In this study, every treatment gave us good to excellent control at planting. The treatments with three or more modes of action as a preemergence burndown received the highest % control whereas the treatments with just two modes of action such as the 2,4-D + Roundup or the Clarity + Roundup were evaluated in the 80-90% range. At 36 days after the early post emergence treatments we can see that the treatments with multiple modes of action and more residual components are able to have longer control. Whereas the treatments that just have the two modes of action discussed earlier are losing their ability to control the Palmer amaranth. However, when an early post emergence application was added to the treatments with just two modes of action, these treatments performed better as compared to the treatments that just received a PRE treatment with two modes of action.

Evaluation of Residual Soybean Herbicides for Palmer Amaranth Control in Soybeans

J. Tredaway, A. Price, and D. Delaney

Treatments

Evaluation of Residual Soybean Herbicides for Palmer Amaranth Control in Soybeans

	Treatments	*Rate*	*Timing*
1	Untreated Check		
2	Valor SX + Dual Magnum	2 oz + 16 fl oz	PRE
2	Prefix + Roundup	32 fl oz + 32 fl oz	POST
3	Surveil	2.1 oz	PRE
3	Prefix + Roundup	32 fl oz + 32 fl oz	POST
4	Fierce	3 oz	PRE
4	Prefix + Roundup	32 fl oz + 32 fl oz	POST
5	Rowel FX	3 oz	PRE
5	Prefix + Roundup	32 fl oz + 32 fl oz	POST
6	Warrant Ultra	48 fl oz	PRE
6	Prefix + Roundup	32 fl oz + 32 fl oz	POST
7	Authority MTZ	14 oz	PRE
7	Prefix + Roundup	32 fl oz + 32 fl oz	POST

Materials and Methods

This study was conducted at the Plant Breeding Unit of the E.V. Smith Research and Extension Center in Tallassee, AL. This trial was initiated as a conventional tillage operation with 7 treatments including an untreated check and 4 replications in the randomized complete block design. The trial was planted on June 9, 2016, and the preemergence applications were applied later that day. An early post application of Prefix + Roundup was applied to each plot except for the untreated checks. Ratings were evaluated a month after the early postemergence application.

Results

Regardless of the system used, the PRE + POST system controlled palmer amaranth and carpetweed at 28 days after planting. It provided good residual however it was planted behind a wheat crop with a lot of stubble. I would like to continue this study on conventional soil and see how the systems compare.

IV. Disease Management

Determining the Relationship of Soybean Vein Necrosis Virus with Morning Glory and Other Weeds in Soybean Fields in Alabama

E. Sikora, k. Conner, L. Zhang, and D. Monks

Soybean vein necrosis virus (SVNV) was first found in Alabama in Limestone County in 2012. Characteristic symptoms of the disease include brown necrotic blotches along major veins of the upper and lower leaf surface, resulting in a scorched appearance of damaged leaves. Previous studies have reported that morning glory (MG) is a symptomless host of SVNV and can act as a source of inoculum for soybean fields. Since 2012 SVNV has been detected in 31 counties in Alabama. Incidence of the disease within a field is typically highest in North Alabama with some fields approaching 100% infection.

In the first year of this project (2014), leaves were collected from MG populations growing adjacent to soybean fields showing symptoms of SVN. Of the seven populations of MG screened for SVNV, only one tested positive for the virus. This MG population was growing next to a soybean field that had 100% incidence of the disease. Incidence of SVNV in adjacent fields to the six MG populations that tested negative for the virus ranged from 4-50%.

In 2015 leaves were collected from MG populations growing adjacent to soybean fields in nine locations. In each case none of the MG plants tested positive for SVNV. Incidence of SVNV incidence typically ranged from 45-85% in soybean fields adjacent to the nine MG populations. Our inability to detect SVNV in the MG population suggests that MG is a poor host in nature for the virus.

In addition to screening populations of MG, we also tested other weed species growing near fields with a history of high levels of SVN incidence. These weeds were collected in the spring of 2015 prior to planting of soybeans, or in the fall after soybeans had senesced in the field. We suspected these weeds could act as overwintering or "bridge" hosts for the virus and play a role in the disease cycle of SVN. Weeds collected and tested included English plantain, white clover, large yellow vetch, Virginia pepperweed, sheperd's purse, Maypop passionflower, field pepperweed, wheat, false garlic, wild carrot, Carolina geranium, curly dock, buckhorn plantain, deadnettle, henbit, golden ragwort and hairy bittercrest. Number of weeds collected and tested varied over three sampling dates but typically ranged from 10-20 specimens of each species. All weeds tested negative for the presence of SVNV.

The objective of this study is to establish the importance of MG and other weeds found near soybean fields to determine their role in the disease cycle of SVNV. In 2016 we will continue to tests weeds adjacent to soybean field looking for alternate hosts of SVNV.

Evaluation of Fungicides for Control of Soybean Rust and Other Foliar Diseases of Soybeans

D. Delaney, E. Sikora, and K. S. Lawrence

Objective

To evaluate multiple fungicides for control of soybean rust and other foliar diseases in Alabama.

Results

Fungicide trials for the control of soybean rust (SBR) and other foliar soybean diseases were conducted at Tennessee Valley, EV Smith and the Gulf Coast REC, for a total of seven trials. Trials included different fungicide products, including new ingredients and premixes, timing and varieties. Some trials were irrigated while most were dryland. Two trials were multi-state cooperative, using the same protocols in each state.

Most trials were late planted due to early season wet weather as well as to increase exposure to soybean diseases, however, periods of late summer dry weather at most locations limited disease development. Hot and dry periods in mid-summer, limited spread of SBR across the state. Frogeye leaf spot was common in some trials in 2017; however, weather limited foliar disease development. Disease severity ratings were recorded wherever sufficient disease was present.

At Tennessee Valley, frogeye leaf spot appeared late in the season. . Although numerical differences were shown, no treatments were significantly different then the untreated check for frogeye, yield or 100-seed weights for the two tests at this locatin. Yields averaged around 60 bu/A for both tests.

At EV Smith, SBR was the primary pathogen. Seven fungicide treatment combinations and rates were applied at the R3 growth stage. Ratings were recorded in early October. The untreated check had a rating of 3.3 of 8 on the BAYER scale. All fungicide treatments significantly reduced SBR ratings to 0.1 or less, but there were no significant differences between the fungicide treatments. Since SBR appeared late in the season, there were no significant differences in yield between the check and any of the fungicide treatments which averaged ~ 58 bu/A.

At Gulf Coast, soybean stands were low due to heavy rains after planting. A multi-state fungicide trial targeting Cercospora leaf blight (CLB) was conducted with fungicide applications applied at R1, R3, R5. Both CLB and SBR appeared at moderate to low levels in early October and were rated. Most fungicides reduced SBR and CLB ratings compared to the untreated control, with the exception of R5-only applications of Priaxor (for SBR and CLB) and Headline (CLB only). Due to poor stand, yields were not affected by fungicide applications, averaging ~ 26 bu/A.

Determining if Soybean Vein Necrosis Virus Causes Yield Loss in Soybeans

Summary 2016 (Year 2 of 3)

E. Sikora, A. Jacobson, K. Conner, J. Kemble, D. Delaney and J. Murphy

Soybean vein necrosis virus (SVNV) has been detected in 31 counties in Alabama since 2012. It is unclear whether SVNV causes significant yield loss in commercial soybean fields. The objective of this study is to determine if SVNV causes yield loss in soybeans. The experiment was conducted at the Tennessee Valley Research Center in Bell Mina. The replicated trial used row covers to prevent thrips feeding and virus transmission from planting through the first 6, 8, or 10 week period of the growing season. Populations of migrating thrips were monitored, SVNV incidence was determined periodically, and yield and seed quality were determined after harvest.

Results: Poor seed quality and low germination led us to replant the test at both locations. At TVS, row covers did an acceptable job of keeping thrips out of the treatments, but once removed insects quickly migrated to the unprotected plants. The majority of thrips captured during the test at TVS were soybean thrips, a known vector of SVNV. Incidence of SVNV was sporadic among the treatments during the season, possibly due to the uneven stands. Drought conditions at TVS late in the season made it difficult to collect disease incidence or severity at crop maturity. Yields were relatively low at TVS, though treatments with row covers had significantly higher yields than the two control treatments. Symptoms of SVNV were not observed at Wiregrass, a location where the disease had not been reported previously. There were no significant difference in yield at this location, possibly due to the fact is was overhead irrigated during the season.

Row cover/SVNV effect on yield at TVS and Wiregrass, 2015 and 2016

TREATMENT	Yield bu/acre		
	TVS-2015	TVS-2016	Wiregrass-2016
Check – uncovered	76.2 d	22.2 b	69.3 a
Insecticide – uncovered	79.4 c	21.6 b	70.1 a
Row cover - 6 weeks	80.4 c	35.9 a	76.6 a
Row cover - 8 weeks	84.4 b	34.7 a	71.1 a
Row cover - 10 weeks	89.5 a	36.3 a	76.2 a

V. Insect Management

Impact of the Parasitic Wasp on Kudzu Bugs

T. Reed and X. P. Hu

Background

The kudzu bug has become a main yield-loss pest since its debut in 2010. It was found to reduce yields by 20% in 2013 at Prattville and in 2014 at Brewton.

In 2013, a parasitoid wasp of kudzu bug egg was first detected in AU campus soybean field. The parasitism rate of this braconid wasp in the field where the wasp was found was as high as 80% late 2013 growing season, when kudzu bug populations increased from 5 to 10 per plant at the V2 stage to 300 per plant at the R6 stage. The same year, this wasp was found in 5 counties across AL.

2014 survey showed a less parasitism rate and much lower kudzu bug population, possibly also due to the cold winter not only hindering the survival of kudzu bugs but the parasitic wasp as well. Collections of 240 kudzu bug egg masses at regular intervals at the Prattville Research Station showed egg parasitism rates ranged from less than 1% on 6/30, to 13% on 7/29 and peaked at 24% on 8/19. The parasitism rate at the Brewton station was 6% on 7/31 the last date soybeans were sampled there. Kudzu bug populations in Auburn soybean fields peaked at only 10 per plant in unsprayed beans.

The 2015 project was to monitor the egg parasitism rate of kudzu bug eggs to determine the impact of the braconid wasp on kudzu bug populations.

A total of 294 kudu bug egg masses were collected weekly then biweekly from 3 unsprayed plots at the Prattville Research center, 2 unsprayed and 2 insecticide-sprayed plots at the Brewton Research Stations. An additional 42 egg masses were collected from AU soybean field where the wasp was first reported.

The data show:

<u>At the Prattville Research Center: See Table 1 and Figure 1</u>

1. The egg parasitism rates increased from <10% in July to 54% in August, then slightly lowered to 45% in September at all the 3 unsprayed plots

2. Kudzu bug populations declined all the season from 23.4 per plant on 7/6 to 0.3 per plant on 1/9.

Table 1. Egg parasitism rate and kudzu bug population dynamic at Prattville

	6-Jul	13-Jul	20-Jul	28Jul	11-Aug	21-Aug	1-Sep
Egg parasitism rate (%)	-	7.9	11.1	33.3	41.2	54.0	45.2
# Kudzu bug per plant	23.4	11.8	4.1	1.5	1.5	0.5	0.3

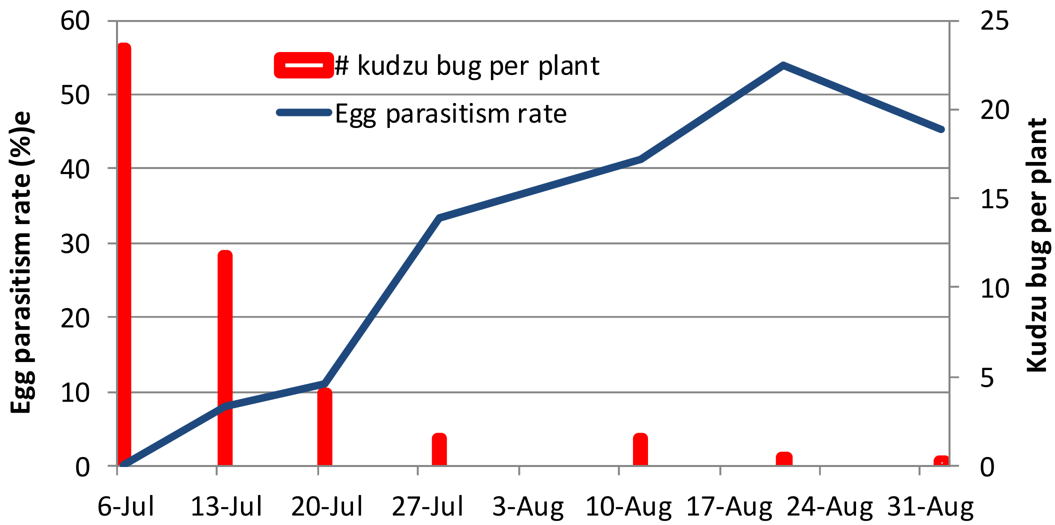


Figure 1. Egg parasitism rate and kudzu bug population dynamic at Prattville

<u>At the Brewton Research Center:</u>

1. The egg parasitism rates increased from <10% in July, peaked to 61-73% in August, and declined in September.
2. The unsprayed plots had significantly higher egg parasitism rates in comparison with that in insecticide-sprayed plots . The parasitism rate at the last collection day on 1/9 was 57.1% in unsprayed plots, which is 3 times higher than the 19% from insecticide-sprayed plots (See Table 2 and Figure 2)
3. The unsprayed plots had relatively higher kudzu bug population in July but relatively lower population in late season, in comparison with the sprayed plots that had lower kudzu bug population after treatment in July but higher population in later season.

4. In unsprayed plots, the egg parasitism rates were higher in Brewton Research Center than Prattville Research Center the entire growing season. (See Table 3 and Figure 3).

Table 2. Comparison of egg parasitism rate (%) from unsprayed and sprayed plots at Brewton

	7-Jul	12-Jul	18-Jul	25Jul	13-Aug	23-Aug	5-Sep
Unsprayed Plots	0	9.5	23.8	45.2	73.8	73.5	57.1
Sprayed Plots	0	7.1	21	42.5	61.6	33.3	19

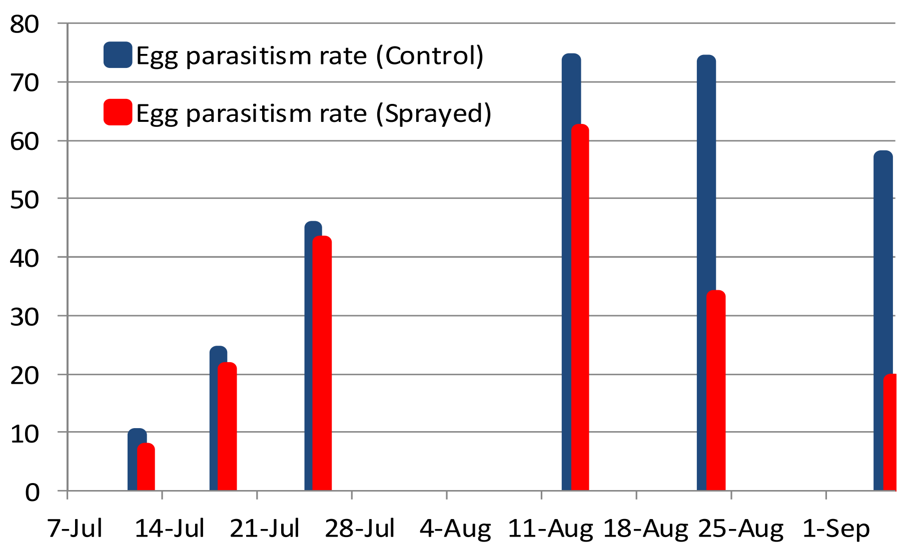


Figure 2. Comparison of egg parasitism rate (%) and kudzu bug population dynamic from unsprayed and sprayed plots at Brewton

Table 3. Comparison of kudzu bug population (#/plant) from unsprayed and sprayed plots at Brewton

	7-Jul	12-Jul	18-Jul	25Jul	13-Aug	23-Aug	5-Sep
Unsprayed Plots	11.5	3.25	1.5	1	0	0	0
Sprayed Plots	6.2	3	2	3	1	2	3

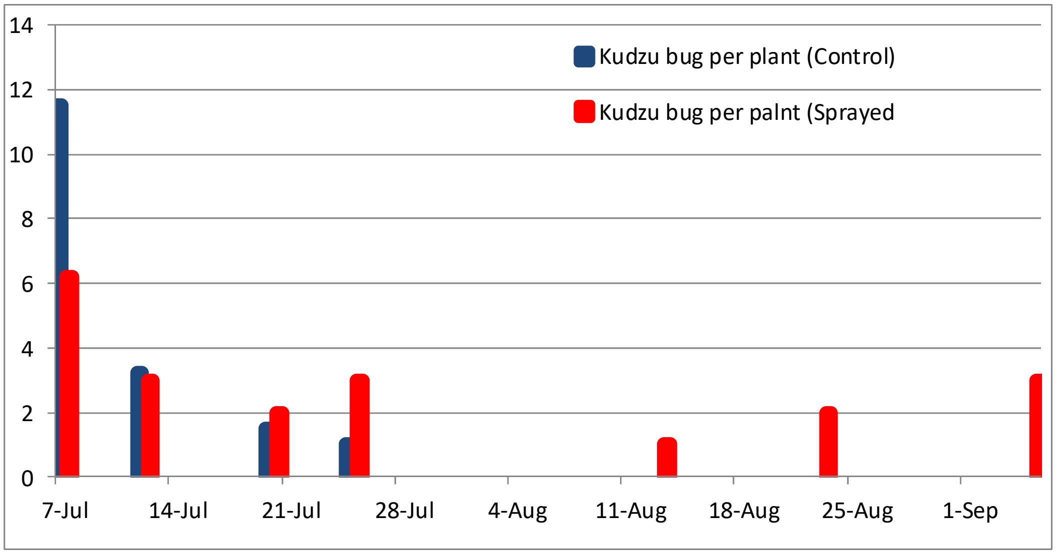


Figure 3. Comparison of kudzu bug population (#/plant) from unsprayed and sprayed plots at Brewton

<u>Auburn University Campus soybean plot: Figure 4.</u>

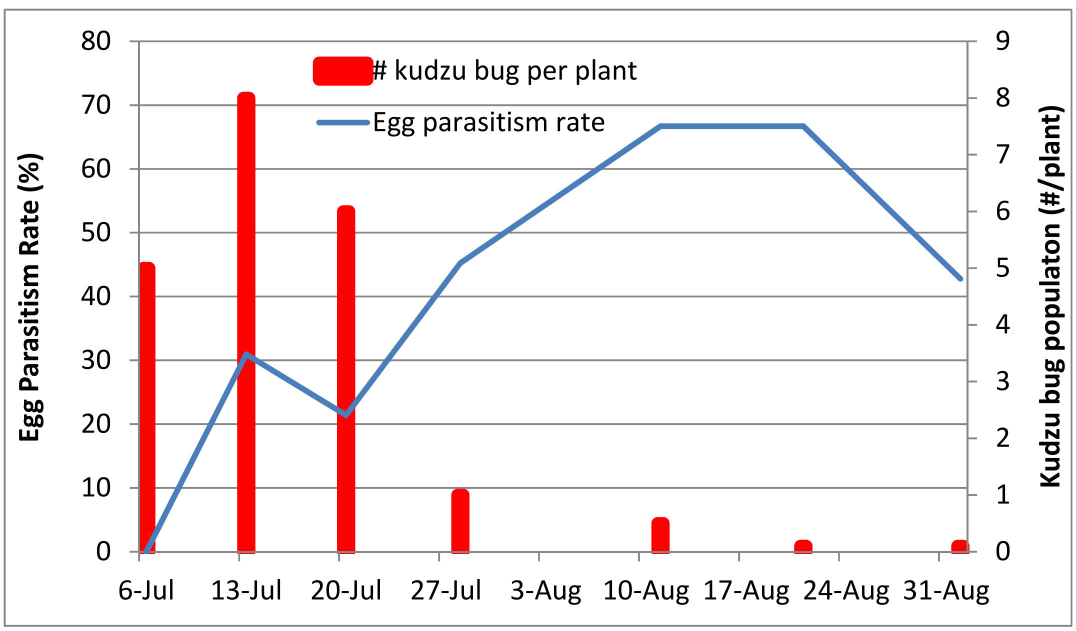


Figure 4. Egg parasitism rate and kudzu bug population dynamic on AU campus

In summary, when no insecticide was sprayed, the parasitism rates of kudzu bug eggs increased and kudzu bug population decreased over season. The parasitism rates of kudzu bug eggs were greater in unsprayed fields in comparison with sprayed fields. The parasitism rates of kudzu bug eggs were higher at Brewton than Prattville. The parasitism rates of kudzu bug eggs remained higher and kudzu bug population lower at unsprayed AU soybean field where the wasp was first discovered.

2014 and 2015 data indicate that this braconid parasite has the potential to suppress the number of kudzu bugs that overwinter in Alabama. This project generates useful documentation in assessing the importance of this parasite in the overall management of kudzu bugs. This knowledge will aid in the development of an optimum integrated pest management plan for preventing economic losses by soybean farmers to kudzu bugs.

On-farm Demonstration of Low-input Biological Control for Suppressing Populations of Kudzu Bugs in Soybean

X.P. Hu and T Reed

This project is to validate previous finding that the specialist braconid wasp, *Paratelenomus saccharalis*, has significant impact as a control agent for kudzu bug in soybeans, through field trials to determine whether or not pesticide sprays are necessary when kudzu bug is at or above the recommended threshold but their eggs are highly parasitized by this wasp; and at what parasitism rate a pesticide spray is needed.

This project was conducted at Prattville Center, not the proposed William Griffiths' Farm. This change is to adjust the cost of travel and operation, because we were awarded half of the proposed budget. Pioneer 95Y70 was planted on May 15, and Pregeny 5555 was planted on June 15, 2016. Plots were 8 rows wide and 30 feet long. Rows were 36 inch spacing.

Treatments: The early-planted soybean had 2 insecticide treatments and 1 unsprayed control treatments with 3 replicates per treatments at random block design (RBD). The late-planted soybean had 1 insecticide treatment and 1 unsprayed control with 3 reps per reatment at RBD.

Insecticide Brigade (Bifenthrin) was sprayed on soybean plants R2 stage using hand-sprayer at 20 gl/acre, because the number of kudzu bug adult/nymph reached 4 per net sweep and egg parasitism rate (visual count) lower than 50% when soybean was at R1. An additional spray was applied 2-4 week after R2 because the survey indicated that the # kudzu bug and parasitism rate remained the similar levels.

Additionally, we surveyed the entire soybean field at the Center to assess the correlation of kudzu bug infestation between broad-leaf and large-seeded vs. narrow-leaf and small-seeded soybean.

Results:

1. The numbers of kudzu bug adult/nymph per sweep and egg-parasitism rate at R5 were presented in Table 1.

Table 1. Efficacy of different treatments in controlling kudzu bug in soybeans, Prattville, AL 2016)

Soybean		2 spray (R2, 3-wk after R2)	1 spray (R2)	No spray	P value
Early-planted	# of KB	3.5 a	4.2 a	15.6 b	< 0.001
	Egg parasitism rate (%)	52 a	76 a	67 a	0.52
Late-planted	# of KB	--	2.8 a	3.1 a	0.762
	Egg parasitism rate (%)	--	34 a	41 a	0.03

2. Kudzu bug population estimates correlated with soybean-plant biological characters are presented in table 2.

Table 2. Correlation of kudzu bug population between soybean varieties at R5 of different biological characters (unknown planting dates, insecticide spray history and variety names)

Broad-leaf, large-seeded	H (> 6 adult/nymph per sweep)
narrow-leaf and small-seeded	L (< 6 adult/nymph per sweep)

From the data, we draw the follow preliminary conclusions:

1. Early-planted soybean: 1 spray at R2 stage reduced kudzu bug numbers by 4-fold compared with control. The spray was applied at R2 if egg-parasitism rate at R1 was < 50% and kudzu bug was ≥4 adult/nymph per sweep. An additional spray was necessary 2wk after if the rate remained <50% and kudzu bug # ≥4 adult/nymph per sweep.
2. Spray after R5 didn't further knock down kudzu bug number because *Beauveria* infection is high
3. Late-planted soybean: No difference in kudu bug # between one spray at R2 and no-spray.
4. Broad-leaf, large-seeded soybeans had higher kudzu bug infestation than narrow-leaf and small-seeded varieties

We expect to continue this work for another 2 years to validate the results and be able to demonstrate the same results on private farms.

Impact of the Parasitic Wasp, *Paratelenomus saccharalis* in Suppressing Populations of Kudzu Bugs Infesting Soybeans in Alabama

T. Reed and X. P. Nu

This study was to understand the impact of kudzu bug (KB) egg parasitoid, *Paratelenomus saccharalis*, on kudzu bug populations affecting soybeans in Alabama, measured by egg parasitism rates. This wasp was 1st discovered by us in soybean plot of AU in June 2013. The parasitization rate dramatically went up from about 10% in June to about 80% when soybeans grew into R6 stage. We initiated this project in 2014, and are generating valuable data to enable us a comprehensive understanding of the impact and future potential of this wasp in keeping KB level under damage threshold.

The wasp parasitoid rates were monitored at four AU research stations. Soybeans were planted between April and late May. Wasp parasitism data were collected from 10 plots at 4 locations: 3 plots at Prattville, 3 at Brewton, 3 at EV Smith, and 1 on AU campus. Plot sizes varied between 4 – 12 rows. All the plots were insecticide sprayed, except for 1 plot in Prattville and 2 plots in Brewton, and the one on AU campus that were unsprayed as control. Egg-masses were surveyed on plants 6 times during growing season from July 1 through September 2016. Twenty 20 egg-masses were examined per plot, making a total of 4,800 egg-masses.

Additionally, to have a better understand about how widely this wasp is in Alabama, we extended the survey to include 42 Alabama counties in 2016. Soybean fields and kudzu patches were visually surveyed.

Results

Table 1. Mean parasitism rate (%) of kudzu bug egg-mass by *Paratelenomus saccharalis*

Location	Plot	07/02	07/19	07/27	08/05	08/15	08/26	09/05
Prattville	A-1	0	0	14.29	9.53	85.71	61.90	61.91
	A-2	0	4.76	19.05	28.5	76.19	95.24	66.67
	A-3	0	0	23.81	42.86	52.38	66.66	71.43
	Average	**0**	**1.59**	**19.05**	**26.98**	**71.43**	**74.60**	**66.67**
Brewton	B-1	4.76	4.76	57.14	52.38	71.43	100	92.86
	B-2	0	4.76	47.62	71.43	80.95	95.24	95.24
	B-3	0	0	38.10	85.71	43.19	100	-
	Average	**1.59**	**3.18**	**47.62**	**69.84**	**65.19**	**97.96**	**94.28**
E.V. S.		07/02	07/19	07/27	08/05	08/15	08/26	09/08

	C-1	0	9.53	33.33	19.05	100	85.71	-
	C-2	0	0	4.76	28.57	42.86	71.43	-
	C-3	0	0	14.29	47.62	90.47	71.43	-
	Average	**0**	**3.18**	**17.46**	**31.75**	**77.78**	**76.19**	**-**
AU		07/02	07/19	08/01	08/08	08/16	08/26	09/08
	D-1	0	0	57.14	66.67	76.19	-	-
	D-2	0	0	4.76	52.38	81.62	61.91	85.71
	Average	**0**	**0**	**30.95**	**59.52**	**78.90**	**61.91**	**85.71**

Table 2. Number of Kudzu bugs on 5 soybean plants (adult in black and nymph in red)

Location	Plot	07/02	07/19	07/27	08/05	08/15	08/26	09/05
Prattville	A-1	3.75	30.75	16.50	47.50	1.50	2.50 0.50	3.50
	A-2	0	2.25	7.75	38.50	5.75	8.75 0	0.50
	A-3	0	8.50	11.50	6.00	0.50 12.50	6.00 0	0.75
	Average	**0**	13.83	11.92	30.67	2.58	5.75 0.17	1.58
Brewton	B-1	21.75	15.75	9.25 28.00	9.50 70.00	29.75 47.75	64.25	40.25
	B-2	13.75	6.00	4.25	6.75 10.75	2.00 16.25	4.00 4.00	3.00
	B-3	5.50	4.00	8.75	8.00	3.50	2.75 3.25	0.50
	Average	13.67	8.58	7.42	8.08	11.75 21.33	23.67 2.42	14.58
E.V. S.		07/02	07/19	07/27	08/05	08/15	08/26	09/08
	C-1	0	8.00	6.50	0.50	1.50	1.50 0	1.75 1.75
	C-2	0	13.50	4.50	8.00	3.75	0.50 12.50	2.25
	C-3	0	23.00	7.00	4.25	3.50	2.25 22.75	1.00
	Average	**0**	14.83	6.00	4.25	2.92	1.42 11.75	1.67 0.58
AU		07/02	07/19	08/01	08/08	08/16	08/26	09/08
	D-1	0.25	12.25	22.25	16.25	6.25	-	-
	D-2	0	13.50	21.50	15.75	12.50 13.50	35.75 42.90	78.50 78.50
	Average	0.13	12.88	21.88	16.00	9.38	35.75 42.90	78.50 78.50

Conclusion and Discussion

The egg parasitism rates showed a similar seasonal pattern at the 4 locations, which were increasing parasitism rates starting in early July and peaking in late August. No significant difference in parasitism rates were detected between locations, as well as between treated plots and unsprayed plots. However, control plots had higher rate in early season than treated plots.

The kudzu bug populations: Brewton had greater kudzu bug infestation than Prattville and EV Smith centers, but no substantial difference between treated and control plots as well.

The two data sets look unreasonable, but consider the slots were not far from slots other researchers were testing. There might have been heavy drift of pesticide from adjacent plots and that influenced the target populations in our slots.

Interested is the plots on AU campus, that were used for herbicide-treated seeds test and had not been sprayed for 2 years. After two year of high parasitism and low KB infestation, the wasp parasitizing rates were lower this year. There was a surge of KB population in later August, because of the cleaning of surrounding host plants, not contributed to low wasp rate.

Supplemental Table. Soybean Plot Locations and Information (2016):

Location	Plot	Soybean Variety	Insecticide spray	PlantingDate	Size
Prattville (713 County Road 4 East, Prattville, AL 36067)	A-1	AG54X6	Brigade on 6/8, 7/15 and 7/26	05/10/16	12 rows
	A-2	Pioneer 95Y70	Brigade on 6/8, 7/15 and 7/26	05/23/16	8rows
	A-3	ASGROW 5935	none	04/29/16	4 rows
Brewton (2067 Kirkland Road, Brewton, AL 36426)	B-1	Pioneer 94Y70RR	none	04/29/16	8 rows
	B-2	Pioneer54T94R	none	05/11/16	8 rows
	B-3	Pioneer P76T54R2	Fungicide in Aug	06/05/16	12 rows
E.V. Smith (4725 County Road 40 Shorter, AL 36075)	C-1	Pregeny5555	Karate on 6/9, Strategoyld (fungicide) on 8/17	05/26/15	12 rows
	C-2	Pregeny5555	Herbicide spay before planting, fungicide STRATEGO YLD spray on 8/17	05/25/16	12 rows
	C-3	Progeny 70310R	Herbicide spray before planting, fungicide STRATEGO YLD spray on 8/17	05/25/16	8 rows
AU	D-1	Pioneer 93Y92	Seed treatment with Roundup PowerMax (glyphosate), Dual Magnum	04/27/16	8 rows
	D-2	Asgrow 5831	Seed treatment with Roundup PowerMax (glyphosate), Dual Magnum	06/15/16	8 rows

Beauveria bassiana as a Control Agent for Kudzu Bug in Soybean Summary for 2016 research Trials (Year 2 of 3)

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The number of kudzu bugs that result in economic yield losses is unknown, however, last year in small plot trials, kudzu bug infestations did not result in yield loss compared to insecticide treated plots. In the last 3 years a naturally occurring fungus has reduced kudzu bug populations, and may be suppressing populations to a level that no longer warrants insecticide applications. This study was conducted to examine whether or not yield reductions occurred in soybean plots infested with *Beauveria bassiana* infected kudzu bugs. Small plot field trials established in Brewton, Prattville, Shorter, and Headland included early- and late- plantings, and insecticide-treated and non-treated plots in each planting date. Kudzu bug infestations were monitored weekly throughout the growing season, and the number of bugs infested with fungus were counted.

In 2015, in Prattville and in Auburn, the number of kudzu bugs per drop cloth sample ranged from 50-200 the second half of August. In 2016, kudzu bug numbers never exceeded 20 in any sample taken during the growing season at these 4 locations. Therefore, a meaningful comparison of yield in infested and uninfested plots could not be made. There were still reports of kudzu bugs occurring in some growers' fields in 2016, however, the level of infestations in these locations was not well communicated. This next year populations of kudzu bug may remain low, or may rebound if populations are able avoid fungal infections. Continued monitoring of kudzu bugs and the prevalence of *Beauveria* in kudzu populations will provide information about the long-term impacts of this fungus on the kudzu bug in Alabama.

The Brown Marmorated Stink Bug – Does It Change the Economic Threshold for the Complex of Stink Bugs Attacking Alabama Soybeans and Will Border Sprays Significantly Reduce Their Numbers Within a Field?

T. Reed

Materials and Methods

Test 1: Test plots to assess brown marmorated stink bug (BMSB) affect on the stink bug complex threshold in soybeans and the effect of border sprays were planted along the northeastern edge of the Prattville station on May 23 using the variety Pioneer 95Y70. Plots were 8 rows wide and 30 feet long and were arranged in a RCB design. There were two bifenthrin treatments applied on 9/02 and 9/06 and the unsprayed treatment. Plots were sampled on 9/08 and 9/22 using a 15 inch-diameter sweepnet and making 10 sweeps across two rows in each plot.

Test 2: Another test was conducted to assess the effect of planting date on BMSB density and gain economic threshold information. Plots (16 rows by 30 ft long) were planted on 4 different planting dates (5/10, 5/23, 6/14 and 6/29 and were sampled on 6 dates between 6/24 and 9/02. 8 rows in each plot were sprayed 3 or 4 times with bifenthrin to reduce stink bug numbers. Yields were taken at plant maturity.

Test 3: The third test was planted on on 8/19 to determine the movement pattern of BMSB's and other stink bugs into late-planted soybeans. The one acre plot was sampled along the east and west edges and in the middle of the plot on 2 sampling dates.

Results

Test 1: Ten sweepnet samples taken in the test plots on 8/18 (plants in late R5 stage)did not detect any BMSB's present. Southern green stink bugs were present at a density of 0.4 per 10 sweeps. Kudzu bugs were present at a density of 161/10 sweeps with over 90% being adults. After plots were sprayed on 9/2 and 9/6 sweepnet counts taken on 9/08 showed a low density of 0.25 BMSB's per 10 sweeps in the untreated plots and a total stink bug density of 3.9/10 sweeps (Table 1). SGSB's and brown stink bugs comprised 93% of the stink bug population. Sweepnet samples taken on 9/22 showed the same density of BMSB's and fewer numbers of other stink bugs in untreated plots (Table 2). Bifenthrin reduced kudzu bug numbers by an average of 97% by 9/08. There was no significant difference among the 3 treatments with respect to yield which ranged from 26.9 bu/acre in the untreated plots to 28.3 bu/acre in one bifenthrin treatment.

Test 2: Sweepnet samples taken in soybeans planted on 4 different dates showed that BMSB numbers did not increase in any plots until 8/17 when numbers increased from 0.375/10 sweeps on 8/03 to 2.3/10 sweeps on planting date (PD) 1. The following week numbers increased again to 2.6/10 sweeps. BMSB numbers did not exceed 0.4/ sweep in any other planting date treatment. Spraying the soybeans did not impact yields in part because the stink bugs moved into the beans after the July 26 spray. PD1 soybeans were in the R5.6 stage on 8/17.

Test 3: No BMSB's were collected in the one acre plot of late planted soybeans. Red banded, Red shouldered, and southern green stink bugs were collected in the late planted field on 10/05 and 10/25 after pod formation. However, BMSB's were still present in the PD1 plots in Test 2 on 10/5. This may indicate that under test conditions the BMSB's may have moved to overwintering sites in October once their host soybeans matured.

Efficacy of Bt Soybeans in Preventing Yield Loss to Caterpillars

T. Reed and R. Smith

Materials and Methods

A total of 10 different entries were planted on July 7, 2016 at the Gulf Coast Research and Extension Center at Fairhope. The entries were all Group 3.5 soybeans and no entry possessed a GMO herbicide-resistant trait. One entry lacked the Bt protein(s). There were 3 replications for each entry with entries arranged in a RCB design. Each plot was 4 rows wide and 30 feet long with a row spacing of 38 inches. Soybeans were grown using standard production practices. Plots were sprayed with 2 oz/acre of Centric to reduce beneficial arthropods on July 21. Plots were sampled for caterpillars by vigorously shaking plants over a 3-foot wide ground-cloth at two locations in each plot oneach sampling date. Rows 1 and 4 were sampled for caterpillars. Plots were sampled 7 times on a weekly schedule from 8/16 through 9/28. Per cent defoliation was estimated on each sampling date. Rows 2 and 3 in each plot were harvested on 10/20. Yields were converted to bushels per acre at 13% moisture.

Results

Few caterpillars were found in the Bt entries and defoliation levels remained below 2% during the study for all Bt entries. Beetles and grasshoppers caused most of this defoliation. There were a few velvetbean caterpillars (VBC) and soybean loopers (SBL) found on the Bt soybeans but these likely developed on morningglories that were present in plots. SBL's were in the plots on the first sampling date and they were present in the trial each week of sampling. The plant stage of development and average number of SBL's /meter of row each sampling date in the non-Bt plots were as follows: R4.9-8/16-5.3/m; R5.2-8/25-1.9/m; R5.4-9/1-3.8/m, R5.6-9/8-3.6/m; R5.8-9/14-8.6/m; R6-9/21-3.8/m; R6.2-9/28-0.4/m. VBC's were the main defoliating caterpillar in this study. Mean number of VBC larvae and % defoliation for the non-Bt entry on each sampling date were as follows. 8/16-0/m-2%; 8/24-0.2/m-3%, 9/1-0/m-3%; 9/8-11.7/m-3%, 9/14-18.3/m-10%; 9/21-13.3/m-35%; ; 9/28-8.8/m-45%. There was no significant difference in yield among the 10 entries (P>F=0.76). Yields in these dry land soybeans ranged from 37.8 to 44.5 bu/ac for the 10 entries with the non-Bt entry yielding 38.4 bu/acre. The higher levels of defoliation occurred after soybeans neared maturity and leaf loss did not impact yield. The Intacta variety with single Bt gene resistance that is currently being planted on 30 million acres in South America was included in the trial. It is likely that commercial varieties of Bt soybeans will be available for sale in the

U.S. in the near future and experiment station evaluation in Alabama provides farmers with an opportunity to gain insight into the value of this new technology.

Effects of Neonicotinoid Seed Treatments and Foliar Sprays on 3-Cornered Alfaalfa Hoppers and Other Insects Infesting Soybeans in 2016

T. Reed

Materials and Methods

This study was conducted at the Brewton and Prattville Agricultural Research Unit. Treatments were arranged at both stations in a factorial design with the variables tested being insecticide seed treatments { (1) Cruiser, (2) Gaucho, (3) Poncho and (4)Untreated with fungicide only} and foliar insecticide sprays { (1) Belay 2.13 @ 6 oz/acre, (2) Brigade 2 @ 6.4 oz/acre (3) Centric 40WG @ 2.5 oz/acre (4) Admire Pro 4.6 @ 1.7 oz/acre and (5) No Foliar Spray}. Liberty Link soybeans were planted May 4, 2016 at Brewton and at Prattville on June 22 using a 36 inch row spacing. Foliar sprays were applied June 9 at Brewton in 20 gallons of water per acre using John Deere PSL DAQ 1002 nozzles and 30 psi. Foliar sprays were applied Aug 4 at Prattville using TX 6 conejet nozzles that delivered 8.5 gallons of water per acre using 50 psi. There were 4 replications for each seed treatment X foliar spray combination. Plot size for each combination was 8 rows wide X 25 feet long. Plots were sampled for 3-cornered alfalfa hoppers (3CAH) and kudzu bugs (KB) using a 15 inch diameter sweep net and ten sweeps across two rows were made in each plot each sampling date. Rows 2 and 3 and 6 and 7 were sampled each sampling date. Sampling dates at Brewton were 5/24, 6/23, 7/12, and 8/03. Sampling dates at Prattville were 8/03 and 8/17.

Results

Brewton: Numbers of 3CAH were low in this study with the highest recorded density for any treatment on any sample date was 3.1 per 10 sweeps. There was no significant seed treatment effect with respect to the number of 3CAH's collected on the first 3 sampling dates (Table 1). However on the 8/03 sampling date there were significantly fewer 3CAH's in the fungicide- only treatment than in the Gaucho and Poncho treatments. There was no significant foliar treatment effect with respect to the number of 3CAH's on any sampling date (Table 2). KB numbers were well below the economic threshold level. There was no significant seed treatment effect with respect to the number of KB's collected on any sampling date or on yield (Table 3). There was no significant foliar spray treatment effect on the first 2 sampling dates with respect to numbers of KB's sampled nor on yield (Table 4). However, on the 8/03 sampling date there were significantly fewer KB's in the untreated plots than in any insecticide- treated plots.

Table 1. Mean number of 3-cornered alfalfa hoppers per 10 sweeps in soybeans planted May 4 and receiving different neonicotinoid seed treatments. Brewton, AL 2016

	Number Per 10 Sweeps			
Seed Treatment	5/24	6/23	7/12	8/03
Fungicide only	1.4	1.9	1.4	1.9 C
Gaucho	1.2	2.1	1.4	2.9 AB
Poncho	1.1	1.4	1.5	3.1 AB
Cruiser	1.6	1.4	1.2	2.3 BC
P>F =	0.52	0.33	0.95	0.04
LSD 0.1 =	---	---	---	0.73

Table 2. Mean number of 3-cornered alfalfa hoppers per 10 sweeps in soybeans receiving different neonicotinoid or pyrethroid foliar sprays on June 9. Brewton, AL 2016

	Number Per 10 Sweeps			
Foliar Treatment	5/24	6/23	7/12	8/03
Untreated	1.3	1.9	1.4	3.0
Admire Pro 1.7 oz/acre	1.6	2.1	1.6	2.1
Centric 2.0 oz/acre	0.6	1.4	0.8	2.0
Belay 6 oz/acre	1.5	1.4	1.3	3.1
Brigade 6.4 oz/acre	1.6	1.6	1.6	2.5
P>F =	0.16	0.48	0.37	0.11

Table 3. Mean number of Kudzu Bugs per 10 sweeps and yields in soybeans planted May 4 and receiving different neonicotinoid seed treatments. Brewton, AL 2016

	Number Per 10 Sweeps				
Seed Treatment	5/24	6/23	7/12	8/03	Bu/Acre
Fungicide only	0	4.8	5.1	20.0	55.0
Gaucho	0	6.0	4.7	15.3	56.4
Poncho	0	5.2	4.2	15.2	54.4
Cruiser	0	6.3	4.5	18.4	52.7
P>F =	---	0.33	0.95	0.33	0.43

Table 4. Mean number of Kudzu Bugs per 10 sweeps and yields in soybeans receiving different neonicotinoid or pyrethroid foliar sprays on June 9. Brewton, AL 2016

	Number Per 10 Sweeps			
Foliar Treatment	6/23	7/12	8/03	Bu/Acre
Untreated	6.1	4.8	8.9 C	57.9
Admire Pro 1.7 oz/acre	6.2	4.6	24.0 A	54.6
Centric 2.0 oz/acre	5.3	5.9	23.9 A	54.5
Belay 6 oz/acre	5.6	3.4	16.6 B	54.3
Brigade 6.4 oz/acre	4.5	4.3	12.4 BC	51.8
P>F =	0.48	0.37	0.0001	0.22
LSD 0.1 =	---	---	5.82	---

Prattville: There was no significant seed treatment effect with respect to number of KB's collected on either sampling date or on yield (Table 5). The percentage of girdled plants was significantly greater in the fungicide-only plots than in the Gaucho plots. Numbers of 3CAH were very low, ranging from 0.45 to 1.1 per 10 sweeps in the seed treatments on 8/03. There was a significant treatment effect with respect to the number of KB's sampled on 8/17 following spray treatments on 8/04 (Table 6). There were significantly more KB's collected in the Admire Pro treatment than in the other treatments.

Table 5. Mean number of Kudzu Bugs per 10 sweeps, percent girdled plants and yields in soybeans receiving different neonicotinoid seed treatments. Prattville, AL 2016

	Number Per 10 Sweeps		Percent Girdled Plants	Yield Bu/Acre
Seed Treatment	8/03	8/17		
Fungicide only	24.5	20.1	11.1 A	39.5
Gaucho	21.8	20.9	6.5 B	37.3
Poncho	20.4	19.8		39.0
Cruiser	25.7	19.4		39.4
P>F =	0.16	0.96	0.086	0.15
LSD 0.1 =	---	---	4.3	---

Table 6. Mean number of Kudzu Bugs per 10 sweeps and yields in soybeans receiving different neonicotinoid or pyrethroid foliar sprays on August 4. Brewton, AL 2016

	Number Per 10 Sweeps		
Foliar Treatment	8/03	8/17	Bu/Acre
Untreated	24.1	18.7 B	38.1
Admire Pro 1.7 oz/acre	20.9	27.4 A	38.9
Centric 2.0 oz/acre	23.6	19.9 B	39.4
Belay 6 oz/acre	22.9	18.4 B	37.9
Brigade 6.4 oz/acre	23.9	15.6 B	39.7
P>F =	0.40	0.0053	
LSD 0.1 =	---	5.2	

Effect of Planting Date on Kudzu Bug Infestation Level and Economic Loss in Alabama Soybeans

T. Reed

Materials and Methods

This study was conducted at the Prattville Agricultural Research Unit. The 4 Planting Dates and the varieties planted on each date were as follows: Planting Date (PD) 1=5/10—AG54X6; PD 2=5/23-Pioneer 95Y70; PD 3=6/14—Pioneer 95Y70; PD 4=6/29—Pioneer 47T36R. There were 4 replications of each planting date with 16 rows in each plot. Half the rows were sprayed with 6.4 oz/acre of bifenthrin on each of the following dates. (Only PD1 and PD2 were sprayed the first spray date) Spray Date (SD) 1=6/8; SD 2=7/15; SD 3=7/26; SD 4= 9/13. Plots were sampled using a 15 inch diameter sweep. Plots were sampled on 6/24, 7/8, 7/13, 7/21, 8/3 and 8/17. 10 sweep net sweeps were made in each plot each time it was sampled.

Results

Sweepnet samples taken on several sampling dates indicated relatively low numbers of 3CAH's were present during the study. The highest mean number recorded was 8 per 10 sweeps on June 7 in the PD1 plots with plants in the early V4 to V5 stage and 8.5 inches tall. The next highest recorded density was 3.5 per 10 sweeps on July 8 in sprayed PD 2 plots . The PD 1 plots also had the highest mean percentage of main stem girdles averaging 36.7% in the unsprayed plots and 32.8% in the sprayed plots. Main stem girdle percentages shown in Table 1 (Page 2) for the sprayed and unsprayed plots for the other 3 planting dates were as follows: PD 2=10.7 and 18.9, PD 3=11.4 and 9.0 and PD 4=6.7 and 17.6. Numbers of kudzu bugs collected on 7 sampling dates are shown in Table 1. Sub-economic threshold levels were present in all planting date treatments. The highest mean number of kudzu bugs collected was 80/10 sweeps in the PD2 unsprayed plots on 7/21. The relatively low insect pressure resulted in yields which were not significantly different by planting date ($P>F = 0.165$); or spray treatment ($P>F = 0.25$).

Table 1. Number of kudzu bugs per 10 sweeps in sprayed and unsprayed soybean plots with different planting dates at Prattville, AL in 2016.

		Number of kudzu bugs per 10 sweeps								
Plant Date	Spray Trt	Date 6/24	Date 7/8	Date 7/13	Date 7/21	Date 8/03	Date 8/17	Date 9/02	Pct girdles	Yield Bu/ac
PD 1	Sprayed	0	25.3	17.8	20.5	5.8	14.3	1.8	36.7a	33.5
PD 1	Unsprayed	0	23.0	25.0	66.8	15.3	15.0	7.8	32.8a	34.3
PD 2	Sprayed	0	10.8	27.8	12.3	5.5	11.0	4.3	10.7cd	36.3
PD 2	Unsprayed	0	21.5	23.8	80.0	13.0	11-8	4.3	18.9b	32.8
PD 3	Sprayed		0	13.5	9.0	10.5	18.5	5.3	11.4b-d	35.4
PD 3	Unsprayed		0.5	13.0	57.0	27.0	23.8	7.3	9.0d	34.2
PD 4	Sprayed	----	---	8.8	1.0	5.3	24.8	8.8	6.7d	40
PD 4	Unsprayed	----	---	14.8	0.5	5.0	33.0	10.5	17.6bc	36.8

Determining the Optimum Insecticide(s) for Controlling the Complex of Caterpillar Species Infesting Soybeans in Alabama

T. Reed and R. Smith

This study was conducted at the Brewton Ag Research Unit. Pioneer 95Y70 soybeans were planted June 3, 2016 using a 36 inch row spacing. Plots were 8 rows wide and 30 feet long. There were 10 insecticide treatments and 2 unsprayed control treatments with 4 reps/treatment arranged in a RCB design. Insecticide treatments were sprayed 8/18 using John Deere PSL DAQ 1002 nozzles 30 psi, and 20 gallons of spray per acre. Plots were sampled with a 3 foot long drop cloth on 8/23 (5DAA) and 8/31 (13 DAA). Plants were shaken vigorously on both sides of the drop cloth at 2 locations in each plot on each sampling date. Defoliation was estimated in each plot on 8/23, 8/31, 9/15 and 9/21. Plants were harvested 11/2 and yields were converted to bushels/acre at 13% moisture.

Results

Numbers of soybean loopers and green cloverworms recovered in the different treatments on both sampling dates are presented in Table 1.

Table 1. Efficacy of different insecticides in controlling soybean loopers and green cloverworms in soybeans. Brewton, AL 2016

		SBL[1] Per 12 feet		**GCW[2] Per 12 Feet**	
Insecticide	**Rate Per Acre**	**5 DAA**	**13 DAA**	**5 DAA**	**13 DAA**
Intrepid Edge	4 oz	12.8 de	0.5 b-d	0.3 b	0.0 b
Intrepid Edge	5 oz	6.0 e	1.8 cd	0.0 b	0.0 b
Besiege	6 oz	23.5 bc	2.5 b-d	0.0 b	0.0 b
Belt	2 oz	37.0 a	1.8 cd	0.0 b	0.0 b
Prevathon	14 oz	14.8 d	1.5 d	0.0 b	0.0 b
Untreated	---	42.0 a	4.3 bc	20.3 a	4.5 a
Brigade + Intrepid	6.4 oz + 5.0 oz	28.3 b	3.0 b-d	0.0 b	0.0 b
Intrepid	5.0 oz	16.5 cd	1.5 d	1.0 b	0.0 b
Brigade	6.4 oz	41.5 a	4.8 b	0.0 b	0.0 b
Blackhawk	2.2 oz	10.25 de	1.5 d	0.5 b	0.0 b
Untreated	---	38.8 a	10.3 a	15.8 a	4.8 a
Besiege	8 oz	18.5 cd	0.8 d	0.0 b	0.0 b
	P>F =	0.000	0.003	0.000	0.000
	LSD 0.1=	8.3	2.6	5.3	1.4

[1] SBL = soybean looper larvae [2] GCW= green cloverworm larvae

All insecticide treatments except Belt and Brigade had significantly fewer SBL larvae than the untreated plots at 5DAA. Brigade + Intrepid and Besiege at 6 oz/ac had significantly more SBL larvae than Prevathon, Blackhawk and both rates of Intrepid Edge. The reduced mortality in the Brigade + Intrepid vs Intrepid alone and the Besiege (which contains chlorantraniliprole + lambda cyhalothrin) vs Prevathon (chlorantraniliprole) at 5DAA may have been due to the anti-feeding effect that pyrethroids have on soybean loopers. The 14 oz/acre rate of Prevathon contains 0.047 lbs a.i. of chlorantraniloprole which is 90% of the amount of active chlorantraniloprole in the 8 oz/acre rate of Besiege. By 13 DAA SBL numbers had declined significantly in all treatments including by 82% in the unsprayed plots. Green cloverworm mortality at 5DAA was at or near 100% in all insecticide treatments. Per cent defoliation failed to reach 10% in any insecticide-treated plot through 9/21 (31 DAA). % Defoliation in unsprayed plots averaged 10, 27, 32 and 40 per cent in unsprayed plots on 8/23, 8/31, 9/15 and 9/21, respectively. Defoliation increased from 27% to 40% in September in control plots due to a significant number of velvetbean caterpillar larvae which failed to develop in any insecticide-treated plots. Per cent defoliation did not exceed the economic threshold before the plants reached the R6 stage and there was no statistically significant treatment effect (at the 90% level of confidence) with respect to yield (P>F= 0.704). Plots yields ranged from 48.1 to 53.0 bu/acre in these irrigated plots.

State Pheromone Trapping Program for Soybean Looper, Soybean Podworm, Tobacco Budworm, and *Heliothis armigera*

T. Reed, A. Jacobson, and R. Smith

A statewide pheromone trapping program was conducted in 2016 to assess the moth activity level for 4 species of lepidoptera which can be pests of soybeans. Species monitored were soybean looper (SL), soybean podworm (SPW), tobacco budworm (TBW) and the potentially invasive species *Heliothis armigera (HA)*. All moths collected in HA traps and many moths caught in SPW traps were tested using a DNA based technique to confirm the species present.The trapping program was conducted from the 3rd week of June through the 2nd week of September. Counties in which traps were placed are presented in the results section.

Results

Soybean Podworm (SPW) moth trap catch numbers were much higher in Baldwin, Elmore and Autauga counties than at the other 4 trapping sites. Baldwin county SPW moth numbers began increasing the 4th week of June (132) and ranged from 282 to 347/week for the next 4 weeks. SPW moth numbers at the Baldwin county site then declined the 1st week of August (136), peaked at 549 the 3rd week of Aug. then declined to 158 or less for the remainder of the year. SPW moth trap catches at the Elmore county site jumped the 1st week of July (419) and except for the 2nd week of Aug (6 caught) the SPW moth catch ranged from 200 to 612 through the 4th week of Sept. The SPW trap catch numbers in Autauga county (Prattville Research unit) peaked the 1st two weeks of Sept. The SPW moth catch at the Macon county site peaked the 1st week of Aug . at 229. The SPW trap catch in Limestone County (Belle Mina Station) began increasing the 4th week of June (78 caught) and peaked the 1st week of Aug.at 181. The only reported economic infestation of pod worms on soybeans in AL in 2016 was in a few fields in north AL in the Hillsboro area within 25 miles of the Belle Mina trapping site. These larvae were in the 6th instar stage on Aug. 6 indicating that eggs were deposited by moths about July 25 when the SPW moth trap catch at Belle Mina was 83 for the week. The Henry county trapping site at the Wiregrass Research Station caught very few SPW moths all season (total of 70). Numbers of SPW moths trapped at the Escambia county site at the Brewton Research station were also low all season and numbers ranged from 40 the 2nd week of Aug. to 2 the 3rd week of Sept.

The Tobacco budworm (TBW) moth trap catch was highest in Elmore county with the largest numbers collected the 3rd week of June (227), the 3rd week of July (236) and the 1st and 2nd weeks of Aug. (ca. 150/week). The TBW moth catch in Baldwin county reached 121 the 2nd week of July then declined for 3 weeks and rebounded to 143 the 2nd week of Aug. before declining again. The Henry county TBW moth catch was highest the 3rd week of June (58), the 1st and 2nd weeks of July (45) and the 3rd week of Aug. (42). The Limestone county TBW catches showed peaks at 38 the 1st week of July, 70 the 4th week of July and 55 the first week of Sept. The Macon county site peaked the 1st week of August at 66. The next highest sampling period was the 3rd week of Aug with 19 collected. The highest number of TBW moths were collected at the Autauga county site the 4th week of July (53), the 2nd week of Aug. (41) and the 2nd week of Sept. (67).

Soybean looper (SBL) moths were the most abundant species trapped in this project. SBL moth numbers increased first in Baldwin county rising steadily from 50 the 3rd week of June to 457 the 2nd week in July. Numbers then ranged from 316 to 604 from the 3rd week of July through the 4th week of Aug. Counts peaked the 1st week of Sept at 1102. A soybean variety trial at the Gulf Coast station was sprayed for soybean loopers onAug. 17. A consultant reported that looper sprays in soybean fields in Baldwin county were initiated the 1st week of August. Escambia county SBL moth numbers increased steadily from 19 the 1st week in July to 680 the 2nd week of Aug. This correlated well with the presence of significant numbers of 6th instar SBL larvae in plots at the Brewton station on August 23. During the next 4 weeks SBL moths averaged 275/week at Brewton. The Elmore county SBL moth catch ranged from 56 to 85 during the 1st through 3rd weeks of July then increased to 151 the 4th week of July. Numbers then Jumped to 437 the 1st week of Aug before declining to 253 the next week. Numbers rebounded to 550 and 590 the next two weeks. The Limestone county trap catch increased from 12 the 3rd week of June to 63 the 3rd week in July. This catch then rose from 122 the last week of July to 490 the 3rd week of Aug. Numbers peaked the 3rd week of Sept. at 1501.

Heliothis armigera (HA) moths were trapped in Baldwin, Escambia and Henry counties. All moths collected in traps baited with Heliothis armigera as well as numerous moths caught in Helicoverpa zea traps were tested and no moths were found to be HA moths.

VI. Nematode Management

Root Knot Nematode Species Identification for Soybeans

K. S. Lawrence, E. Sikora, D. Delaney, P. Donald, and W. Groover

Justification

The Root-knot nematode is common in Alabama and as soybean acreage has increased this nematode has become more of a management problem. Two separate surveys indicate that more than 10% of Alabama soybean fields have a detectable level of root-knot nematodes. Successful crop rotations depend on identification of the root knot nematode species and races present in the field. In Alabama, we have the southern cotton root-knot, peanut-root knot and soybean root-knot and they are not crop specific.

Objective

Our objectives are to collect root knot nematode samples from across the state and determine the species and races present using the traditional host differential test, morphological characterization, modified isozyme analyses of root-knot nematode species, and DNA analysis. Root-knot nematodes populations were collected from soybean fields displaying nematode problems in Alabama during the 2016 season. The populations were collected from seven locations across three counties (Covington, Butler, and Escambia). Root-knot populations were increase in the greenhouse at the Plant Science Research Center on the Auburn University campus. The traditional host-differential tests were established for each population in the greenhouse this fall semester. The nematode populations are allowed to increase on tomato, watermelon, pepper, tobacco, cotton, peanut, corn, and soybean for 45 days and populations are quantified to determine species and races present in the field. Populations were also analyzed via morphological measurements and molecular genetic identification. DNA analysis was run on individual second stage juveniles from these populations using primers specific to species found in this region.

Preliminary results

The majority of Root-knot nematode populations found so far have been determined to be *Meloidogyne incognita* race 3, or our southern root-knot nematode, using the host differential tests. *Meloidogyne arenaria* race 1 has also been found on multiple peanut populations. Three more tests are ongoing in the greenhouse currently.

Several molecular protocols have been tested for distinguishing the most common and economically important Root-knot nematode species. DNA was extracted from individual second-stage juvenile nematodes of the root knot populations collected and increased in the greenhouse. DNA was extracted and amplified by PCR. JB3 and JB5 primer sets have identified our Root-knot samples as *Meloidogyne,* and multiple specific primers have identified our Root-knot samples as *Meloidogyne incognita.* These species-specific primer sets are known as MI-F/MI-R, Inc-K14F/Inc-K14R, and Finc/Rinc. The primer set Far/Rar has also been used to successfully identify populations off peanut collected in south Alabama as *Meloidogyne arenaria*.

Outcome

The pathogenic Root-knot populations collected from soybean fields in Alabama to date have been identified as *Meloidogyne incognita* race 3 by the host plant differential test, morphological characteristics, and as *Meloidogyne incognita* with species-specific primers. *Meloidogyne arenaria* race 1 has been identified only on peanut. We are working on the isozyme and DNA analysis.

AMOUT REQUESTED

Total costs will be $10,000

1. Salaries
2. Graduate student (1/2) time - $7,500
    1. Benefits- $ 135
3. Operating
    a. Travel -$1,000
        i. Trips to collect root knot nematode across the state.
    b. Supplies -$1,365
        i. Isozyme analysis chemical supplies and kits.

Soybean Variety Trials with Nematicides to Boost Yield Potential

K. S. Lawrence, E. Sikora, D. Delaney, and D. Dyer

Justification

Seed treatment nematicides are now available to soybean producers. How much yield loss are the reniform and root-knot nematodes causing? Will nematicides enhance soybean yield in nematode infested fields?

Objective

To determine the yield potential of soybeans planted in nematode infested field and the benefit on the new nematicides.

Materials and Methods

Field trial: Five commercial soybean varieties were evaluated with and without the seed treatment nematicide Avicta for their performance in reniform and root-knot nematode infested fields. The soybean varieties were planted in a reniform infested field and in a clean field without reniform at the TVREC. The varieties were also planted in an identical manner in a root-knot nematode infested field and a in a clean field without root-knot at the PBU and GCREC. Nematode samples were collected near 30 days after planting by digging up four plants and extracting the reniform eggs from the roots. Plots were mechanically harvested.

Results

TVREC field trial: Reniform nematode egg counts per gram of root were 49 % lower in the Avicta nematicide treated varieties compared to the same varieties without a nematicide. The presence of the seed treatment nematicide Avicta significantly reduced reniform reproduction on UA5414RR reducing reniform nematode eggs by 65%. Although, the reniform population densities were still higher than those supported by the resistant varieties Mycogen 5N522R2 and USG 75T40. Soybean variety trials yield in the reniform infested field averaged 26.5 bu/A. The addition of Avicta did not increase significantly yield in 2016. Soybean yields in the clean field without reniform averaged 40 bu/A thus the reniform nematode reduced soybean yields by 13.5 bu/A or 33 % in 2016.

Table 1. Soybean varieties reniform population densities and yields when grown in fields with and without reniform and with and without nematicides, TVREC 2016.

	Variety	Reniform eggs/gm root			Yield bu/a		
		Reniform No Avicta	Reniform Avicta	No Reniform	Reniform No Avicta	Reniform Avicta	No Reniform
1	Mycogen5N522R2*	212 bcd	87 cd	0	35 b-e	38 abc	49 a
2	USG 75T40*	193 bcd	106 cd	0	26 e-h	32 abc	39 abc
3	Asgrow 5935	1021 ab	493 bcd	0	27 e-h	26 bc	29 c-f
4	Progeny 5333RY	993 ab	650 a-d	0	19 f-h	27 ab	44 ab
5	UA 5414RR	1536 a	529 bcd	0	18 gh	16 h	38 abc
Average		**791**	**373**	**0**	**25**	**27.8**	**39.8**

Means followed by same letter do not significantly differ according to Tukeys test (P ≤ 0.1)
* Indicates root-knot nematode resistant varieties. ** Indicates root-knot susceptible varieties.

PBU field trial: Root-knot nematode egg counts per gram of root were 21% less in the Avicta nematicide treated soybean varieties than the same varieties without Avicta. The nematicide treatment did not significantly decrease nematode populations when compared to the same varieties without the nematicide in 2016. Treatment with the Avicta nematicide did not significantly increase yield in 2016. Yield of soybean varieties in the root-knot clean field were 7.9 bu/A or 20% higher than the yields of the same soybean varieties without Avicta in the root-knot infested field.

Table 2. Soybean varieties root-knot population densities and yields when grown with and without nematicides, PBU 2016.

	Variety	Root-knot eggs/gm root			Yield bu/a		
		Root-knot No Avicta	Root-knot Avicta	No Root-knot	Root-knot No Avicta	Root-knot Avicta	No Root-knot
1	Mycogen5N522R2*	2183 bc	2400 abc	0	40 ab	41 ab	34 ab
2	USG 75T40*	5328 ab	5473 ab	0	26 ab	31 ab	33 ab
3	Asgrow 5935	2513 abc	1303 c	0	39 ab	38 ab	47 a
4	Progeny 5333RY	6194 a	3065 abc	0	18 b	24 ab	37 ab
5	UA 5414RR	3310 abc	3212 abc	0	30 ab	34 ab	43 a
Average		**3905**	**3091**		**30.8**	**33.5**	**38.7**

Means followed by same letter do not significantly differ according to Tukeys test (P ≤ 0.1)
* Indicates root-knot nematode resistant varieties. ** Indicates root-knot susceptible varieties.

GCREC field Trial: The Avicta nematicide did not significantly reduce root-knot nematode eggs per gram of root in 2016, however, Avicta treated varieties had 51% lower eggs per gram of root than the varieties without the nematicide seed treatment. The yields of soybean varieties planted in the root-knot clean field were 4.2 bu/A or 8% higher than that of the soybean varieties without

Avicta planted in the root-knot infested field. The soybean varieties treated with Avicta were 5 bu/A or 11% higher in yield than the same varieties without Avicta in the infested field.

Table 3. Soybean varieties root-knot population densities and yields when grown in fields with and without root-knot and with and without Avicta neamticide, GCREC 2016.

	Variety	Reniform eggs/gm root			Yield bu/a		
		Root-knot No Avicta	Root-knot Avicta	No Root-knot	Root-knot No Avicta	Root-knot Avicta	No Root-knot
1	Mycogen5N522R2*	96 a	88 a	0	46 abcd	48 abcd	45 bcd
2	USG 75T40*	300 a	209 a	0	34 d	42 cd	41 cd
3	Asgrow 5935	838 a	81 a	0	63 abc	71 ab	72 a
4	Progeny 5333RY	513 a	621 a	0	27 d	40 cd	31 d
5	UA 5414RR	313 a	45 a	0	38 cd	32 d	33 d
Average		**412**	**209**	**0**	**41.8**	**46.7**	**45**

Means followed by same letter do not significantly differ according to Tukeys test ($P \leq 0.1$)
* Indicates root-knot nematode resistant varieties. ** Indicates root-knot susceptible varieties.

Outcome
The reniform and root-knot nematodes reduced soybean yields by 33%, 20%, and 8% respectively in 2016. The seed treatment nematicide Avicta reduced both reniform and root-knot nematode populations. Soybean yield overall was increased by the addition of the nematicide in 2016.

Amount requested
Total costs that will be $10,000

1. Salaries
2. Wages
3. Graduate student (1/2) time - $7,500
    1. Benefits- $ 135
4. Operating
    a. Travel -$2,365
        i. Trips to the TVREC and PBU cost $500 in mileage and meals each and we expect to monitor the fields monthly during the season.

Evaluation of BioST Nematicide for Root-Knot Nematode Management on Soybean in Central Alabama, 2017

N. Xiang, K. S. Lawrence, W. Groover, S. Till, D. Dyer, K. Gattoni, M. N. Rondon, and M. Foshee

The nematicide BioST was evaluated along with SAR and TM for the management of root-knot nematode on cotton in a naturally infested field at the Plant Breeding Unit of the E. V. Smith Research Center near Tallassee, AL. The soil is Kalmia loamy sand with 80% sand, 10% silt, and 10% clay. Seeds treated with basic fungicide and insecticide and Avicta Complete Bean were used as controls. The nematicide BioST, SAR, and TM were applied as seed treatments. Plots consisted of 2 rows, 7 m long with 0.9 m spacing and were arranged in a randomized complete block design with five replications. Blocks were separated by a 6 m wide alley. All plots were maintained with standard herbicide, insecticide, and fertility production practices throughout the season as recommended by the Alabama Cooperative Extension System. The trial was planted on 25 Apr. Plant growth parameters including seedling stand and seeding survival at 21 days after planting (DAP), plant height, shoot fresh weight, and root fresh weight were measured at 35 DAP. Root-knot nematode egg counts were obtained from four whole root systems per plot at 35 DAP. Plots were harvested on 17 Oct. Data were analyzed by ANOVA using PROC GLIMMIX with SAS 9.4 (SAS Institute, Inc., Cary, NC) and means compared with the Tukey-Kramer method at the significant level of 0.1. Monthly average maximum temperatures from planting in April through harvest in October were 27, 28, 30, 33, 33, 29, and 25°C with average minimum temperatures of 12, 14, 19, 21, 21, 17, and 12°C, respectively. Rainfall accumulation for each month was 8.28, 19.66, 18.16, 13.01, 1.04, 0.00, and 5.77 cm with a total of 65.92 cm over the entire season. The rainfall was adequate in May, June, and July but became limited through the remainder of the season. Temperatures were normal over this season for heat units.

Plant stand ranged from 106 to 125 per 7 m of row and percent survival ranged from 70% to 83% which were similar among all the treatments. Plant height, and shoot and root fresh weights were similar across all the treatments. Root-knot nematode population density was high in this experiment. Root-knot nematode population densities were statistically similar among all the treatment but numerically difference was observed. The Avicta Complete Bean, BioST 8 oz/a + SAR HU, BioST 10 oz/a, and BioST 10 oz/a + SAR Lit all numerically reduced root-knot nematode eggs per gram of root (eggs/gr) by 31%, 26%, 24%, and 23%, respectively as compared to the fungicide & insecticide treatment. Soybean yields were not significantly different but did vary by 908 kg/ha across all treatments. The BioST 10 oz/a + SAR Lit treatment yielded the highest, numerically, followed by BioST 10 oz/a, BioST 8 oz/a + TM, BioST 8 oz/a, and Avicta Complete Bean treatments.

		21 DAP	21 DAP	35 DAP	35 DAP	35 DAP	35 DAP	176 DAP
No.	Seed Treatment[z]	Stand[y]	Survival[x]	Plant height (cm)	Shoot fresh weight (g)	Root fresh weight (g)	*Meloidogyne incognita* eggs/gr[w]	Soybean yield (kg/ha)[v]
1	Fungicide & Insecticide	125	83	16.4	24.6	12.0	1205	1675
2	BioST 8 oz/a	112	75	14.4	19.7	11.5	1264	2011
3	BioST 10 oz/a	119	79	15.5	21.1	12.0	918	2092
4	BioST 8 oz/a + SAR HU	106	70	14.5	19.0	11.0	893	1621
5	BioST 8 oz/a + SAR EE	107	71	13.4	17.4	8.5	1623	1002
6	BioST 8 oz/a+ TM	112	74	15.7	24.5	11.2	1431	2085
7	Avicta Complete Bean	108	72	16.9	24.4	12.9	827	1991
8	BioST 10 oz/a + SAR Lit	111	74	14.8	19.3	12.0	924	2529

[z]Treatments included a base fungicide & insecticide and Avicta + Vibrance & IMD as industry standards and the application rates were as labeled.
[y]Stand was the number of seedlings in 7 meter of row.
[x]Survival was the percentage of seedlings survived at 21 DAP divided by total number of seeds planted per plot multiply by 100.
[w]*Meloidogyne incognita* eggs/gr means root-knot nematode in 4 root systems.
[v]Data were analyzed by ANOVA using PROC GLIMMIX with SAS 9.4 (SAS Institute, Inc., Cary, NC) and means compared with Tukey-Kramer at $\alpha \leq 0.10$.

Fertilizer and Nematicide Combination Evaluations for Root-Knot Nematode Management in Southern Alabama, 2017

W. Groover, K. S. Lawrence, S. Till, D. Dyer, and N. Xiang

The nematicide Avicta, the plant hormone Ascend, and the fertilizers Micro 500, Sure-K, and a 10-34-0 blend were tested in various combinations in a *Meloidogyne incognita* (root-knot nematode) infested field for soybean yield increase. This test was planted in the field at the Brewton Agricultural Research Unit near Brewton, Alabama. This field has been artificially inoculated with the root-knot nematode over the past few years. The soil type is Benndale fine sandy loam, which contains 73% sand, 20% silt and 7% clay. Avicta was applied as a seed treatment. Ascend, Micro 500, and Sure-K were all applied as an in-furrow spray at planting. The 10-34-0 fertilizer was applied as a 2x2 spray at planting. Planting occurred on 12 May. Plots consisted of 4 rows that were 6.6 meters long with 1-meter row spacing, and seeds planted at 2.54 cm depth. The plots were arranged in a RCBD with five replications of each treatment. All plots were maintained throughout the season with standard herbicide, insecticide, and fertility production practices, and a lateral irrigation system was used for watering as needed. Plant height, shoot fresh weight, root fresh weight, and nematode population data were collected at 35 days after planting (DAP) from 4 plants per plot. Nematodes were extracted from the soybean roots using 6% NaOCl, collected on a 25-um sieve and recorded as total eggs per gram of root. Harvest occurred on 25 October at 166 DAP. Data was analyzed by ANOVA in SAS 9.4 (SAS Institute Inc.) and means were compared using Tukey-Kramer with $P \leq 0.1$. Monthly average maximum temperatures from planting in May through harvest in October were 28.5, 28.9, 32.4, 31.3, 29.8, and 26.1°C with average minimum temperatures of 15.4, 20.3, 21.5, 21.5, 18.2, and 14.3°C, respectively. Average temperatures from May to October was 21.9, 24.6, 26.9, 26.4, 24.0, and 20.22°C. Rainfall accumulation for each month was 26.2, 35.1, 14.3, 19.6, 7.3, and 14.9 cm, respectively.

Root-knot nematode populations were relatively high in 2017 with heavy rainfall all season. The Avicta + Ascend + 10-34-0 treatment (12) plant height average was higher ($P \leq 0.1$) than most other treatments. The root fresh weights of Avicta + Ascend (6), Avicta + 10-34-0 (8), and Avicta + Ascend + 10-34-0 (12) were all higher ($P \leq 0.1$) than the control. The shoot fresh weight of Avicta + Ascend + 10-34-0 (12) was higher ($P \leq 0.1$) than most other treatments. Root-knot nematode egg counts were substantial at 35 DAP, however, no egg numbers were statistically lower than the control. There were no statistical differences between the yields of any treatments.

No.	Treatment	Rate	Plant Height*	Root Fresh Weight	Shoot Fresh Weight	Eggs/g root	Yield kg/ha
1	Untreated Control		13.0 dc**	8.2 c	30.7 cde	341 abcd	2084
2	Avicta	0.15 mg ai/seed	12.7 d	9.8 bc	33.1 bcde	154 d	2152
3	Ascend	47.87 mL/ha	13.7 abcd	8.8 bc	31.8 cde	216 bcd	2151
4	Micro 500 Sure-K	0.38 L/ha 1.5 L/ha	12.5 d	8.1 c	28.3 e	147 d	1883
5	10-34-0	18 kg/ha	13.5 abcd	10.2 bc	30.9 cde	163 cd	2219
6	Avicta Ascend	0.15 mg ai/seed 47.87 mL/ha	13.4 abcd	10.2 b	37.8 abc	667 a	1883
7	Avicta Micro 500 Sure-K	0.15 mg ai/seed 0.38 L/ha 1.5 L/ha	13.2 bcd	9.2 bc	32.7 cde	303 abcd	2018
8	Avicta 10-34-0	0.15 mg ai/seed 18 kg/ha	14.4 ab	10.3 b	40.1 ab	589 ab	2421
9	Ascend Micro 500 Sure-K	47.87 mL/ha 0.38 L/ha 1.5 L/ha	13.4 abcd	8.5 bc	30.2 de	388 abcd	2219
10	Ascend 10-34-0	47.87 mL/ha 18 kg/ha	14.1 abc	9.8 bc	35.7 abcd	290 abcd	2488
11	Avicta Ascend Micro 500 Sure-K	0.15 mg ai/seed 47.87 mL/ha 0.38 L/ha 1.5 L/ha	13.6 abcd	9.5 bc	34.4 bcde	132 d	1950
12	Avicta Ascend 10-34-0	0.15 mg ai/seed 47.87 mL/ha 18 kg/ha	14.45 a	12.7 a	41.9 a	586 abc	2085

*Plant height was the average of four plants measured in centimeters.

**Column numbers followed by the same letter are not significantly different at $P \leq 0.1$ as determined by Tukey's multiple-range test.

Fertilizer and Nematicide Combination for Reniform Nematode Management on Soybean in Central Alabama, 2017

W. Groover, K. S. Lawrence, N. Xiang, S. Till, and D. Dyer

The fertilizers Micro 500, Sure-K, 10-34-0 and the plant hormone Ascend were used in conjunction with the nematicide Avicta in a *Rotylenchulus reniformis* (reniform nematode) infested soybean field for yield evaluations. This test was planted at the E.V. Smith Research Center near Tallassee, Alabama. This field has been previously inoculated with the reniform nematode over the past few years. The soil type is Benndale fine sandy loam, which contains 73% sand, 20% silt and 7% clay. Avicta was applied as a seed treatment. Ascend, Micro 500, and Sure-K were all applied as an in-furrow spray at planting. The 10-34-0 fertilizer was applied as a 2x2 spray at planting. Planting occurred on 5 May. Plots consisted of 24 rows that were 7.6 meters long with 1-meter row spacing, and seeds planted at 2.54 cm depth. The plots were arranged in a RCBD with five replications. All plots were maintained throughout the season with standard herbicide, insecticide, and fertility production practices, and a lateral irrigation system was used for watering as needed. Plant height, biomass, and nematode population data were collected at 39 days after planting (DAP) from 4 plants per plot. Nematodes were extracted from the soybean roots using 6% NaOCl, collected on a 25-um sieve and recorded as total eggs per gram of root. Harvest occurred on 20 October at 168 DAP. Data was analyzed by ANOVA in SAS 9.4 (SAS Institute Inc.) and means were compared using Tukey-Kramer with $P \leq 0.10$. Monthly average maximum temperatures from planting in May through harvest in October were 27.8, 29.8, 33.4, 32.5, 29.3, and 25.2°C with average minimum temperatures of 11.8, 14.4, 19.2, 20.6, 20.3, 16.8, and 12.4°C, respectively. Average temperatures from May to October was 19.3, 21.1, 24.5, 27.1, 26.4, 23.1, and 18.8°C. Rainfall accumulation for each month was 8.3, 19.7, 18.2, 13.0, 1.0, 0, and 5.8 cm, respectively.

Reniform nematode populations were relatively high in 2017. Plant height was greater for the Avicta treatment (2) ($P \leq 0.1$) than five other treatments (3, 5, 6, 8, and 12). The biomass of Ascend + 10-34-0 (10) was higher ($P \leq 0.1$) than three other treatments (4, 8, 12). Reniform nematode egg numbers were substantial at 39 DAP, with the Avicta + Micro 500 + Sure-K having higher ($P \leq 0.1$) nematode eggs per gram of root than all other treatments. The Avicta (2) and 10-34-0 (5) soybean yields were higher ($P \leq 0.1$) than the Avicta + Ascend + 10-34-0 (12) yield.

No.	Treatment	Rate	Plant Height[z]	Biomass[y]	Eggs/g root	kg/ha
1	Untreated Control		24.4 abcd[x]	97.6 abcd	102 ab	3968 ab
2	Avicta	0.15 mg ai/seed	26.7 a	107.0 abc	30 b	4573 a
3	Ascend	47.87 mL/ha	24.0 bcd	94.2 abcd	33 b	3901 ab
4	Micro 500 Sure-K	0.38 L/ha 1.5 L/ha	24.2 abcd	85.9 bcd	29 b	3632 ab
5	10-34-0	18 kg/ha	22.8 cd	105.2 abc	9 b	4304 a
6	Avicta Ascend	0.15 mg ai/seed 47.87 mL/ha	24.1 bcd	108.9 ab	19 b	3833 ab
7	Avicta Micro 500 Sure-K	0.15 mg ai/seed 0.38 L/ha 1.5 L/ha	24.8 abc	101.3 abcd	175 a	3833 ab
8	Avicta 10-34-0	0.15 mg ai/seed 18 kg/ha	22.1 d	84.2 cd	35 b	3901 ab
9	Ascend Micro 500 Sure-K	47.87 mL/ha 0.38 L/ha 1.5 L/ha	25.1 abc	107.3 abc	26 b	3699 ab
10	Ascend 10-34-0	47.87 mL/ha 18 kg/ha	25.2 abc	109.6 a	21 b	3833 ab
11	Avicta Ascend Micro 500 Sure-K	0.15 mg ai/seed 47.87 mL/ha 0.38 L/ha 1.5 L/ha	25.7 ab	102.7 abcd	12 b	3968 ab
12	Avicta Ascend 10-34-0	0.15 mg ai/seed 47.87 mL/ha 18 kg/ha	23.2 bcd	81.3 d	18 b	3430 b

[z]Plant height was the average of four plants measured in centimeters.
[y]Biomass was the calculation of average shoot fresh weight + root fresh weight.
[x]Column numbers followed by the same letter are not significantly different at $P \leq 0.1$ as determined by Tukey's multiple-range test.

Soybean Variety and Nematicide Evaluation in a Root-Knot Nematode Infested Field in Southern Alabama, 2017

W. Groover, K. S. Lawrence, N. Xiang, S. Till, D. Dyer, M. Foshee, M. N. Rondon, and K. Gattoni

Five soybean varieties were evaluated for their performance in a *Meloidogyne incognita* (root-knot nematode) infested field along with the addition of the nematicide Avicta. This test was planted at the Gulf Coast Research and Extension Center near Fairhope, Alabama. The field has been artificially infested with the root-knot nematode since 2014. The soil type is Malbis sandy loam, which contains 59% sand, 31% silt and 10% clay. Planting occurred on 24 April. Plots consisted of 2 rows that were 7.6 meters long with 1-meter row spacing, and seeds planted at 2.54 cm depth. The plots were arranged in a RCBD with five replications. Plots were designed with a split plot arrangement consisting of 2 rows with and 2 rows without Avicta. Avicta was applied as a seed treatment. All plots were maintained throughout the season with standard herbicide, insecticide, and fertility production practices and a lateral irrigation system was used for watering as needed. Plant height, biomass, and nematode population data were collected at 31 days after planting (DAP) by digging up four random plants per plot for both untreated and treated rows. Nematodes were extracted from the soybean roots using 6% NaCl and collected on a 25-um sieve and recorded as total eggs per gram of root. Harvest occurred on 10 October at 164 DAP. Data was analyzed by ANOVA in SAS 9.4 (SAS Institute Inc.) and means were compared using Tukey-Kramer with $P \leq 0.10$. Monthly average maximum temperatures from planting in April through harvest in October were 26.6, 27.6, 29.3, 31.6, 31.2, 29.8, and 26.5°C with average minimum temperatures of 14.1, 17.4, 21.4, 23.5, 22.7, 19.8, and 16.1°C, respectively. Average temperatures from April to October was 20.3, 22.6, 25.4, 27.6, 26.9, 24.8, and 21.3°C. Rainfall accumulation for each month was 8.4, 26.5, 24.5, 14.8, 29.1, 1.2, and 32.1 cm, respectively.

Reniform nematode disease pressure was high in the 2017 season. Soybean variety by nematicide was not significant for any of the variables, thus data were pooled for analysis. Soybean variety selection had a significant impact on plant height and total yield ($P \leq 0.10$). Plant height averages by variety ranged from 32.9 to 39.8, with varieties Asgrow 5935, UA 5414, and USG 75T40 being higher ($P \leq 0.10$) than Progeny 5226 and Credenz 5375. The nematicide treatment Avicta significantly affected plant height, biomass, and nematode eggs per gram of root. Avicta led to a higher ($P \leq 0.10$) biomass versus the untreated soybeans. Avicta also decreased ($P \leq 0.10$)

nematode eggs per gram of root compared to the untreated soybeans. Soybean varieties Asgrow 5935 and Progeny 5226 yields were higher ($P \leq 0.10$) than UA 5414, USG 75T40, and Credenz 5375.

Treatment	Plant Height (cm)	Biomass (g)[z]	Eggs/g root	Yield (kg/ha)
Split-plot analysis *P*(F)				
Soybean Variety	<0.0001[x]	0.7169	0.2388	<0.0001
Nematicide	<0.0001	<0.0001	<0.0001	0.4872
Variety x Nematicide	0.5499	0.3869	0.2686	0.4557
Nematicide vs. No Nematicide Means				
Avicta[y]	43.9 a	301.9 a	12 b	2690
Untreated	30.7 b	106.4 b	170 a	2757
Soybean Variety Means				
Asgrow 5935	38.8 a	217.7	50	3833 a
Progeny 5226	32.9 b	217.6	128	3564 a
UA 5414	41.9 a	207.5	58	2354 b
USG 75T40	39.8 a	207.5	70	2085 b
Credenz 5375	33.1 b	186.9	150	2152 b

[Z]Biomass is the sum of root and shoot weights in grams.
[Y]Avicta (Abamectin) was applied as a seed treatment at a rate of 0.15 mg AI/seed
[X]Column numbers followed by the same letter are not significantly different at $P \leq 0.1$ as determined by Tukey's multiple-range test.

Nematicide and Fertilizer Combinations for Root-Knot Nematode Management on Soybean in Central Alabama, 2017

W. Groover, K. S. Lawrence, N. Xiang, S. Till, and D. Dyer

The nematicide Avicta, the plant hormone Ascend, and the fertilizers Micro 500, Sure-K, and a 10-34-0 blend were used in various combinations in a *Meloidogyne incognita* (root-knot nematode) infested soybean field for yield evaluations. This test was planted at the Plant Breeding Unit near Tallassee, Alabama. This field is naturally infested with root-knot nematode at a large population density. The soil type is Kalmia loamy sand, which contains 80% sand, 10% silt and 10% clay. Avicta was applied as a seed treatment. Ascend, Micro 500, and Sure-K were all applied as an in-furrow spray at planting. The 10-34-0 fertilizer was applied as a 2x2 spray at planting. Planting occurred on 3 May. Plots consisted of 2 rows that were 7.6 meters long with 1-meter row spacing, and seeds planted at 2.54 cm depth. The plots were arranged in a RCBD with five replications. All plots were maintained throughout the season with standard herbicide, insecticide, and fertility production practices, and a lateral irrigation system was used for watering as needed. Plant height, biomass, and nematode population data were collected at 30 days after planting (DAP) from 4 plants per plot. Nematodes were extracted from the soybean roots using 6% NaCl and collected on a 25-um sieve and recorded as total eggs per gram of root. Harvest occurred on 31 October at 181 DAP. Data were analyzed by ANOVA in SAS 9.4 (SAS Institute Inc.) and means were compared using Tukey-Kramer with $P \leq 0.10$. Monthly average maximum temperatures from planting in May through harvest in October were 27.8, 29.8, 33.4, 32.5, 29.3, and 25.2°C with average minimum temperatures of 14.4, 19.2, 20.6, 20.3, 16.8, and 12.4°C, respectively. Average temperatures from May to October was 21.1, 24.5, 27.1, 26.4, 23.1, and 18.8°C. Rainfall accumulation for each month was 19.7, 18.2, 13.0, 1.0, 0, and 5.8 cm, respectively.

Root-knot nematode populations were relatively high in 2017. The Avicta + Micro 500 + Sure-K treatment (7) plant height average was ($P \leq 0.1$) higher than the 10-34-0 treatment (5). The biomass weight of Avicta + Micro 500 + Sure-K (7) was higher ($P \leq 0.1$) than the Ascend + Micro 500 + Sure-K treatment (9). Root-knot nematode egg numbers were very substantial at 30 DAP, with the Micro 500 + Sure-K treatment (4) being higher ($P \leq 0.1$) than the Ascend (3) treatment.

The Avicta + Micro 500 + Sure-K treatment (7) had the numerically highest soybean yield at 3093 kg/ha, and was statistically higher than three other treatments (4, 5, and 11).

No.	Treatment	Rate	Plant Height[z]	Biomass[y]	Eggs/g root	Yield (kg/ha)
1	Untreated Control		16.2 ab[x]	56.4 ab	594 ab	2634 abc
2	Avicta	0.15 mg ai/seed	14.4 ab	44.9 ab	323 ab	2757 abc
3	Ascend	47.87 mL/ha	16.0 ab	58.1 ab	145 b	2765 abc
4	Micro 500 Sure-K	0.38 L/ha 1.5 L/ha	14.2 ab	55.0 ab	757 a	2152 bc
5	10-34-0	18 kg/ha	13.8 b	43.4 ab	221 ab	2018 c
6	Avicta Ascend	0.15 mg ai/seed 47.87 mL/ha	15.7 ab	57.9 ab	208 ab	2624 abc
7	Avicta Micro 500 Sure-K	0.15 mg ai/seed 0.38 L/ha 1.5 L/ha	16.5 a	66.6 a	420 ab	3093 a
8	Avicta 10-34-0	0.15 mg ai/seed 18 kg/ha	15.5 ab	55.7 ab	295 ab	2691 abc
9	Ascend Micro 500 Sure-K	47.87 mL/ha 0.38 L/ha 1.5 L/ha	14.9 ab	40.2 b	473 ab	2893 ab
10	Ascend 10-34-0	47.87 mL/ha 18 kg/ha	14.0 ab	42.0 ab	391 ab	2690 abc
11	Avicta Ascend Micro 500 Sure-K	0.15 mg ai/seed 47.87 mL/ha 0.38 L/ha 1.5 L/ha	14.0 ab	42.1 ab	258.8 ab	2219 bc
12	Avicta Ascend 10-34-0	0.15 mg ai/seed 47.87 mL/ha 18 kg/ha	16.4 ab	59.7 ab	566.9 ab	1062 abc

[z]Plant height was the average of four plants measured in centimeters.
[y]Biomass was the calculation of average shoot fresh weight + root fresh weight.
[x]Column numbers followed by the same letter are not significantly different at $P \leq 0.1$ as determined by Tukey's multiple-range test.

Nematicide and Fertilizer Combinations for Root-Knot Nematode Management on Soybean in Northern Alabama, 2017

W. Groover, K. S. Lawrence, N. Xiang, S. Till, and D. Dyer

The nematicide Avicta, the plant hormone Ascend, and the fertilizers Micro 500, Sure-K, and a 10-34-0 blend were used in various combinations in a *Rotylenchulus reniformis* (reniform nematode) infested soybean field for yield evaluations. This test was planted at the Tennessee Valley Research and Extension Center near Belle Mina, Alabama. The field was infested with the reniform nematode in 2007 and has been continuously cultivated in cotton. The soil type is Decatur silt loam, which contains 24% sand, 49% silt and 11% clay and 1% organic matter. Avicta was applied as a seed treatment. Ascend, Micro 500, and Sure-K were all applied as an in-furrow spray at planting. The 10-34-0 fertilizer was applied as a 2x2 spray at planting. Planting occurred on 10 May. Plots consisted of 24 rows that were 7.6 meters long with 1-meter row spacing, and seeds planted at 2.54 cm depth. The plots were arranged in a RCBD with four replications. All plots were maintained throughout the season with standard herbicide, insecticide, and fertility production practices, and a lateral irrigation system was used for watering as needed. Plant height, biomass, and nematode population data were collected at 34 days after planting (DAP) from 4 plants per plot. Nematodes were extracted from the roots using 6% NaOCl, collected on a 25-um sieve, and recorded as total eggs per gram of root. Harvest occurred on 18 Oct at 161 DAP. Data were analyzed by ANOVA in SAS 9.4 (SAS Institute Inc.) and means were compared using Tukey-Kramer with $P \leq 0.10$. Monthly average maximum temperatures from planting in May through harvest in October were 27.6, 30.3, 33.1, 31.4, 28.4, and 24.4°C with average minimum temperatures of 15.3, 19.2, 21.7, 20.7, 15.9, and 11.4°C, respectively. Average temperatures from May to October was 21.4, 24.8, 27.4, 26.1, 22.2, and 17.9°C. Rainfall accumulation for each month was 15.3, 15.9, 15.3, 6.0, 9.7, and 8.7 cm, respectively.

Reniform nematode populations were relatively high in 2017 with adequate rainfall all season. The Avicta + Ascend treatment (6) plant height average was higher ($P \leq 0.1$) than the Avicta + Micro 500 + Sure-K treatment (7). The biomass weights of Avicta (2) and 10-34-0 (5) were higher ($P \leq 0.1$) than the Avicta + Ascend + 10-34-0 treatment (12). Reniform nematode egg numbers were substantial at 34 DAP, with the control (1) having a greater ($P \leq 0.1$) number of reniform eggs per gram of root than all but the Avicta + 10-34-0 (8) combination. The Ascend plant growth regulator treatment (3) had the highest soybean yield at 4506 kg/ha, and was statistically similar to the pop up fertilizer 10-34-0 alone (5). These two increased yield by 1008 and 739 kg/ha compared to the control.

No.	Treatment	Rate	Plant Height*	Biomass	Eggs/g root	Yield (kg/ha)
1	Control		10.9 ab**	16.9 abc	367 a	3498 c
2	Avicta	0.15 mg ai/seed	10.6 ab	20.0 a	60 bc	3765 bc
3	Ascend	47.87 mL/ha	10.6 ab	17.1 abc	19 c	4506 a
4	Micro 500 Sure-K	0.38 L/ha 1.5 L/ha	10.9 ab	17.2 abc	30 c	3834 bc
5	10-34-0	18 kg/ha	11.1 ab	20.0 a	8 c	4237 a
6	Avicta Ascend	0.15 mg ai/seed 47.87 mL/ha	11.4 a	19.4 ab	87 bc	3632 c
7	Avicta Micro 500 Sure-K	0.15 mg ai/seed 0.38 L/ha 1.5 L/ha	10.3 b	18.3 abc	150 bc	3765 bc
8	Avicta 10-34-0	0.15 mg ai/seed 18 kg/ha	11.3 ab	15.2 bc	222 ab	3765 bc
9	Ascend Micro 500 Sure-K	47.87 mL/ha 0.38 L/ha 1.5 L/ha	11.1 ab	19.0 abc	89 bc	3565 c
10	Ascend 10-34-0	47.87 mL/ha 18 kg/ha	11.3 ab	15.7 abc	117 bc	3632 c
11	Avicta Ascend Micro 500 Sure-K	0.15 mg ai/seed 47.87 mL/ha 0.38 L/ha 1.5 L/ha	10.8 ab	16.3 abc	12 c	3699 bc
12	Avicta Ascend 10-34-0	0.15 mg ai/seed 47.87 mL/ha 18 kg/ha	10.5 ab	14.5 c	50 c	3632 c

*Plant height was the average of four plants measured in centimeters.
**Column numbers followed by the same letter are not significantly different at $P \leq 0.1$ as determined by Tukey's multiple-range test.

Soybean Variety and Nematicide Evaluation in a Reniform Infested Field in Northern Alabama, 2017

W. Groover, K. S. Lawrence, N. Xiang, S. Till, D. Dyer, M. Foshee, M. N. Rondon, and K. Gattoni

Five soybean varieties were evaluated for their performance in a *Rotylenchulus reniformis* (reniform nematode) infested field along with the addition of the nematicide Avicta. This test was planted at the Tennessee Valley Research and Extension Center near Belle Mina, Alabama. The field was infested with the reniform nematode in 2007 and has been cultivated in cotton for over 17 years. The soil type is Decatur silt loam, which contains 24% sand, 49% silt and 11% clay and 1% organic matter. Planting occurred on 10 May. Plots consisted of 2 rows that were 7.6 meters long with 1-meter row spacing, and seeds planted at 2.54 cm depth. The plots were arranged in a RCBD with five replications. Plots were designed with a split plot arrangement consisting of 2 rows with and 2 rows without Avicta. Avicta was applied as a seed treatment. All plots were maintained throughout the season with standard herbicide, insecticide, and fertility production practices and a lateral irrigation system was used for watering as needed. Plant height, biomass, and nematode population data were collected at 34 days after planting (DAP) by digging up four random plants per plot for both untreated and treated rows. Biomass was calculated as the sum of the root fresh weight and the shoot fresh weight in grams. Nematodes were extracted from the soybean roots using 6% NaOCl, collected on a 25-um sieve and recorded as total eggs per gram of root. Harvest occurred on 18 October at 161 DAP. Data was analyzed by ANOVA in SAS 9.4 (SAS Institute Inc.) and means were compared using Tukey-Kramer with $P \leq 0.10$. Monthly average maximum temperatures from planting in May through harvest in October were 27.6, 30.3, 33.1, 31.4, 28.4, and 24.4°C with average minimum temperatures of 15.3, 19.2, 21.7, 20.7, 15.9, and 11.4°C, respectively. Average temperatures from May to October was 21.4, 24.8, 27.4, 26.1, 22.2, and 17.9°C. Rainfall accumulation for each month was 15.3, 15.9, 15.3, 6.0, 9.7, and 8.7 cm, respectively.

Reniform nematode disease pressure was high in the 2017 season. Soybean variety by nematicide was not significant for any of the variables, thus were pooled for analysis. Soybean variety selection had a significant impact on plant height, biomass, nematode eggs per gram of root, and total yield ($P \leq 0.10$). Plant height averages by variety ranged from 13.2 to 11.1, with varieties Asgrow 5935, UA 5414, and USG 75T40 being taller than Progeny 5226 and Credenz 5375 ($P \leq$

0.10). Plant biomass of Asgrow 5935 was greater ($P \leq 0.10$) than the four other varieties followed by Progeny 5226, which was higher ($P \leq 0.10$) than UA 5414, USG 75T40, and Credenz 5375. Reniform egg numbers were substantial at 34 DAP. USG 75T40 supported the numerically lowest population of reniform nematode eggs per gram of root at 83, which was statistically lower than UA 5414 ($P \leq 0.10$). Asgrow 5935 and Progeny 5226 had the highest yields at 3497 and 3094 kg/ha respectively, and were statistically higher ($P \leq 0.10$) than UA 5414, USG 75T40, and Credenz 5375.

Treatment	Plant Height (cm)	Biomass (g)[z]	Eggs/g root	Yield (kg/ha)
Split-plot analysis *P*(F)				
Soybean Variety	<0.0001[x]	<0.0001	0.095	<0.0001
Nematicide	0.3354	0.3479	0.665	0.3870
Variety x Nematicide	0.9554	0.2904	0.9832	0.8629
Nematicide vs. No Nematicide Means				
Avicta[y]	12.4	15.6	246	2690
Untreated	12.1	14.9	281	2757
Soybean Variety Means				
Asgrow 5935	13.1 a	20.8 a	325 ab	3497 a
Progeny 5226	11.1 b	17.6 b	180 ab	3094 a
UA 5414	13.2 a	13.8 c	426 a	3421 bc
USG 75T40	12.7 a	13.4 cd	83 b	2084 c
Credenz 5375	11.3 b	10.7 d	304 ab	2556 b

[Z]Biomass is the sum of root and shoot weights in grams.
[Y]Avicta (Abamectin) was applied as a seed treatment at a rate of 0.15 mg AI/seed
[X]Column numbers followed by the same letter are not significantly different at $P \leq 0.1$ as determined by Tukey's multiple-range test.

VII. Extras

Off-Target Academy for Field Demonstration and Field Days

J. Tredaway, C. Hicks, T. Sandlin, and K. Wilkins

Trials

These trials were conducted at two locations. One was in North Alabama at the Tennessee Valley Research and Extension Center in Belle Mina, AL, and the other was conducted at the Plant Breeding Unit at E.V. Smith Research and Extension Center in Tallassee, AL. The demonstrations at the Plant Breeding Unit were showcased during the East Alabama Crops Tour on August 25, 2016, The demonstrations at Tennessee Valley were showcased during a crops tour conducted by Tyler Sandlin.

1. **Sprayer Clean Out Demonstration**

   In this demonstration, a 50 gallon tractor sprayer was used to illustrate the importance of proper tank cleanout and the consequences of not cleaning your tank out properly after applying dicamba. To demonstrate this, we filled the tractor tank up with a full load and simulated spraying a field. After the sprayer sprayed for five minutes we drained the tank and went immediately to a field of regular Roundup ready soybeans. The sprayer was turned on and driven through the field. As you would expect, the first thirty feet where the application was made resulted in absolute plant death. After that initial plant death area the injury became less evident as you moved along. The tractor was then taken back up and the tank was dumped and refilled with a water and detergent solution for cleaning. The nozzles and screens were all taken off and cleaned in detergent water as well. The tractor was also sprayed off to ensure any dicamba that landed on the undercarriage or tires was removed as well. After the detergent was sprayed through lines it was then dumped and refilled again. This tank then went back to the field to spray the second pass. Very little injury was seen at this time, due to the detergent based clean. The tractor was then taken back up and dumped of this load and then refilled to rinse and spray out the lines a third time. This would simulate the Triple Rinse which is the correct way to clean a tank of dicamba. After the third rinse the tractor sprayer was filled again and taken back out to the field for the third spray. This time, there was no injury on the dicamba susceptible soybeans, which demonstrated that the triple rinse is the safest route when cleaning out your spray tank.

2. **Dose Response Demonstration**

In this demonstration, simulated drift rates were applied over the top of regular Roundup Ready Soybeans to show the different responses of susceptible soybeans to dicamba drift. The 1/10x rate killed the soybeans. The 1/100x rate knocked the meristem out of the top of the plant and it did not grow any bigger after the application. The 1/1000x rate early showed some leaf cupping and crinkling of the leaves at both timings. There was very little if any injury that occurred in the 1/10000x rate at either timing.

Simulated Drift Demonstration Treatment List

	Treatment	*Rate*	*Timing*
1	Untreated	1/10X	V4
2	Engenia + NIS	1/100X	V4
3	Engenia + NIS	1/1000X	V4
4	Engenia + NIS	1/10000X	V4
5	Engenia + NIS	1/1000X	R2
6	Engenia + NIS	1/10000X	R2

3. **Auxin Tolerance Demonstration**

In the Auxin tolerance demonstration we applied the different auxin herbicides to show that you could not use different herbicide technologies interchangeably. Dicamba tolerant cotton can only tolerate Dicamba, and not the other auxins like 2,4-D, Enlist Duo, and Status. When these other auxins were sprayed on the dicamba tolerant beans it resulted in total plant death.

Auxin Tolerance Demonstration Treatment List

	Treatment	*Rate*
1	Engenia	12.8 fl oz
2	2,4-D	22 fl oz
3	Status	5 oz
4	Enlist Duo	75 fl oz

4. **Weed Height Demonstration**

In the weed height demonstration, the applications were made every two to seven days to illustrate that the weed height at application has an effect on the weed control observed. The dicamba tolerant soybeans were around a week old when the first applications were made and then subsequent applications were made every week at Tennessee Valley and every 2-4 days at the Plant Breeding

Unit. The targeted weed heights were 2, 4, 6, and 8 inches tall. As you would expect the taller the plants get the less they were able to control the growing weeds. Each treatment received the standard rate of Engenia which is 12.8 fl oz.

	Treatment	*Rate*	*Timing*
1	Untreated		
2	Engenia	12.8 fl oz	2 inches
3	Engenia	12.8 fl oz	4 inches
4	Engenia	12.8 fl oz	6 inches
5	Engenia	12.8 fl oz	8 inches

Improving Soil Quality in Alabama

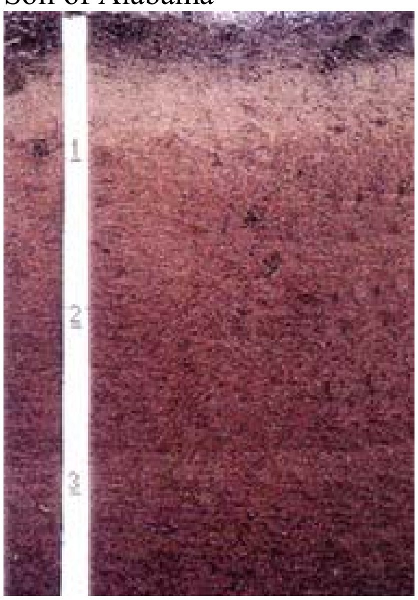
G. Huluka and C. C. Mitchell

Objective

Support Alabama producers who wish to have their soils tested using the new **Alabama Soil Quality Test** through the A.U. Soil Testing Lab.

Justification

Bama sandy loam, the State Soil of Alabama



Alabama Soybean Committee supported the research that led to the development of the Alabama Soil Quality Test and the Soil Quality Index (SQI) that is included in the new report. The A.U. Soil Testing Laboratory is the first and only public-supported laboratory that offers this type of service in the South. It was announced in November, 2015. One of the objectives of the effort that led to its development was to keep the cost as low as possible. Auburn University requires that all "service centers" including the Soil Testing Lab generate funds to cover their expenses. The new, comprehensive Alabama Soil Quality Test will cost $50 per sample which is half of what the Cornell University Soil Quality Test costs. Many Alabama producers and consultants who are used to paying $7 for a routine soil test may not submit soil quality samples at $50 each in spite of the fact that the Soil Quality Test includes:

Routine Soil Test

Micronutrients and heavy metals (soil contamination)

Soil CEC and Base Saturation

Soil Organic Matter

Aggregate stability/slaking test

Soil respiration (biological)

Potential N mineralization

SQI interpretation and recommendations

Report 2016

We have made significant efforts to publicize the availability of the Alabama soil quality test at Auburn University through extension county agents, Master Gardeners' class and through published media. It was also dominantly displayed on the AU Soil, Forage and Water Testing website (http://www.aces.edu/anr/soillab/soilquality.php). Currently, less than 100 samples were submitted to our lab. This is much less than we expected and we will continue encouraging our producers to take advantage of the discounted price of the test and benefit from knowing the health of their soils. An example of a report for Alabama soil quality index is presented blow. The customer will receive the SQI report, routine soil test report and mineral analysis that includes micro elements.

An Example of Alabama Soil Quality Index (SQI) Report

Alabama Soil Quality Index

Name: John Doe
Address: AL St
Sample no. 2063
Previous crop: Corn

Date of Report: 12/01/16
County: AL County
Sample name: LRMT 306 0-6
Tillage:

Factor	Values					Max. value	Your Score	Recommendations
Soil CEC/soil group	<4.6 (Grp 1)	4.7-9.0 (Grp 2)	9.0- 15.0 (Grp.3)	>15,0 (Grp 4)				
	2	4	5	5		5	2	
Soil pHw	<5.0	5.0-5.8	5.9-7.0	7.1--8.0	>8.0			
	0	10	15	10	5	15	15	
P RATING	VL/LOW	MEDIUM	HIGH	VERY HIGH	EXTREMELY HIGH			
	0	5	10	5	0	10	10	
K RATING	VL/LOW	MEDIUM	HIGH	VERY HIGH	EXTREMELY HIGH			
	0	5	10	8	5	10	10	
Base saturation	<10%	11-25%	26-50%	50-75%	>75%			
	0	3	6	10	8	10	10	
Soil O.M. (%)	<1.0	1.0-2.0	2.1-3.0	3.1-4.0	>4.0			PP1, PP2, PP3, SP7
	0	5	10	15	20	20	5	

N mineralized (lb/a)/year	<10	11-20	21-30	31-50	>50			PP1, PP3, PP4
	0	2	4	8	10	10	2	
Soil respiration (mg CO_2/kg) week	Very Low	Low	Moderate	High	Very High			PP1, PP2, PP3, PP5, SP7
	0	2	4	8	10	10	2	
Aggregate stability	No aggregates	Weak	Moderate	Strong	Very strong aggregates			PP1, PP2, PP3, SP7
	0	2	4	8	10	10	2	
Metals	Two or more metals "very high"		One metal is "very high"		All metals optimum			
	-10		-5		0	0	0	
TOTAL SOIL QUALITY INDEX						100	58	
COMMENTS: Moderate soil quality, continue current practices but consider implementing more BMPs. Soil could use improvement. Consider implementing one or more of the above practices.								See BMPs above.

Primary Practices (PP)

PP1. Conservation crop rotation (328)
http://efotg.sc.egov.usda.gov/references/public/AL/tg328.pdf

PP2, Residue and Tillage Management "No-till/strip till" (329)
http://efotg.sc.egov.usda.gov/references/public/AL/tg329.pdf

PP3. Cover crops (340) http://efotg.sc.egov.usda.gov/references/public/AL/tg340.pdf

PP4. Nutrient management (590)
http://efotg.sc.egov.usda.gov/references/public/AL/tg590.pdf

PP5. Integrated Pest Management (595)
http://efotg.sc.egov.usda.gov/references/public/AL/tg595.pdf

Supporting Practices (SP)

SP1. Contour Farming (330) http://efotg.sc.egov.usda.gov/references/public/AL/tg330.pdf

SP2. Deep Tillage (324) http://efotg.sc.egov.usda.gov/references/public/AL/tg324.pdf

SP3. Forage and Biomass Planting (512) – for sod based rations
http://efotg.sc.egov.usda.gov/references/public/AL/tg512.pdf

SP4. Irrigation water Management (449)
http://efotg.sc.egov.usda.gov/references/public/AL/tg449.pdf

SP5. Contour Buffer Strips (332) http://efotg.sc.egov.usda.gov/references/public/AL/tg332.pdf

SP6. Filter Strips (393) http://efotg.sc.egov.usda.gov/references/public/AL/tg393.pdf

SP7. Mulching (345) http://efotg.sc.egov.usda.gov/references/public/AL/tg484.pdf

SP8. Terrace (600) http://efotg.sc.egov.usda.gov/references/public/AL/tg600.pdf

Complete list of conservation practices can be found at:
http://efotg.sc.egov.usda.gov/toc.aspx?CatID=321

Proposal 2017

Subsidize 50% of the cost of the first 500 samples submitted in order to encourage producers to submit samples. Samples will, of course, have to be limited to 5 per producer as an introductory offer. This offer will remain in effect until 500 samples have been run by the lab.

A statement on each report will be, *"This Soil Quality Test has been run at a 50% discount because of checkoff support from* Alabama Soybean Committee*."* Other sources of funding are being solicited. If more than one source is obtained, then the discount will apply to additional samples.

Requested budget for 2017: $12, 500.00

System Biology of Plant-Growth Promoting Rhizobacteria (PGPR) Induced Drought Tolerance in Soybean

S. W. Park and E. Sikora

Objective

The focus of our laboratories is to develop new soybean line(s) which confers drought tolerance and growth promotion. Towards that, the proposed studies aim to generate novel genetic repertoire and candidates for the later generation of GM soybean.

Significance

Our preliminary study unveiled that that cohabitation of soil borne PGPR (i.e., *Paeniba- cillus polymyxa* CR1, Ppc1) enables to induce (**prime**) drought tolerance (Fig. 1), and concurrently growth promotion (data not shown) in soybean. In other word, Ppc1-treatment enables soybean plants to induce genes and metabolites which promote a state of heighten tolerance/resistance against drought stresses, even before the actual state of drought. At the same time, Ppc1 also are able to promote plant growth and development.

For the past decades, a number of studies have searched and, in fact, reported several genes, involved in drought avoidance or tolerance. However, most if not all of these genes were turned out to be not suitable for the development of drought tolerance crops, because these are drought responsive genes, **a)** induced after plants recognize water deficiency, and **b)** render one way or the other stomatal closure. Hence, controlling level expression of these genes results in growth retardation and delay. Thus, the identification of gene(s) that is capable of priming drought tolerance without, if not enhance, com- promising growth will provide new genetic and bio- technological resources to solve one of the most eminent and immediate environmental challenges in the world, drought and global warming.

Fig 1. Application of Ppc1 enhances drought tolerance in soybean. Soybean were treated (+) with Ppc1 (10^8 colony-forming unit per mL) twice **p**ost seed **g**ermination (pg; e.i., 1 and 7 d-pg). Each pot was watered (15 mL) every other day for 2 wk-pg, and the photograph was taken 3 wk-pg.

Results

To Discern genes whose expression pat- terns are linked with 'drought priming', system biol- ogy approach will be employed, and reconstitute the global landscapes of dynamic gene expression changes that occur across multiple levels in the Ppc1-responsive network. Towards this end, we will initially perform **a**) time-course high resolution qRT-PCR analyses using a set of four Ppc1-induced genes (hevein-like protein, vegetative storage protein, RAS-related protein 18, and low temperature Induced protein 78; MPMI 12:951). These results then will allow us to determine when to extract mRNA (condition- al gene expressions) for **b**) the subsequent, global gene expression analysis (i.e., affymetrix genechip, http://www.affymet rix.com/ estore/).

Ppc1 induces the expression levels of *LTI78*, *HEL*, *VSP1*, and *RAB18* at as early as 6 h-post inocu- lation (hpi). As an initial gene expression analysis, we employed semi-quantitative (semi-q)RT-PCR, and resolved Ppc1-depednent temporal changes in the transcript levels of four Ppc1-induced (marker) genes from mRNA, prepared every 6 hpi after the 1^{st} inoculation at 9 am in the morning, and the 2^{nd} inoculation at 48 hpi (Fig. 2). From these data, we concluded that the 1^{st} Ppc1-inoculation **a**) induces rapid (<6 hpi), and perhaps global, rearrangement in transcriptome, and **b**) leads second and third phase upregulations (e.g., 18 and 36 hpi in *VSP1*, or 24 and 30 hpi for *RAB18*). On the other hand, **c**) the 2^{nd} Ppc1-treatment conveys lesser impact on than the 1^{st} Ppc1-treatment the induction of *VSP1* and *RAB18*, although the up- regulation of *VSP1* was still observed at again 6 hp-2^{nd} inoculation.

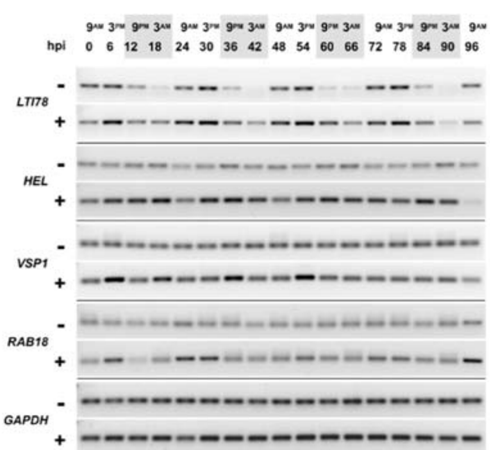


Fig2. Time resolved semi-qRT PCR analyses of *LTI789*, *HEL*, *VSP1* and *RAB18* upon Ppc1 inoculation. Total RNA (+) was prepared from leaves at every 6 hp-1^{st} Ppc1 inoculation at 9 am in the morning. The 2^{nd} batch of Ppc1 was inoculated at 48 hpi. The control RNA (-) was prepared with buffer treatment. Transcript levels of *GAPDH* were used as an equal loading control. Plants were grown under diurnal conditions (12h- light/12-h dark) for 4 wk

Expression of *LTI789* and *HEL* is under control of the circadian clock regulatory mode.

Our semi- qRT PCR analyses (Fig. 2) found that basal (-) levels of *LTI78* and *HEL* expression are rhythmically expressed during a 24-h period. We thus examined if the circadian clock controls the expression of *HEL* and *LTI78* using high resolution qRT- PCR analyses (Fig. 3). While plants were entrained under 12-h light/12-dark diurnal conditions, *LTI78* expression was peaked at early afternoon (3 pm; zeitgeber time [ZT] 8), and *HEL* expression was highest at night (11 pm; ZT16), suggesting that **a**) *LTI78* and *HEL* expressions are regulated by light or diurnal signaling, **b**) cross network between circadian clock regulatory and drought priming modes, for instance Ppc1-induction of *LTI78* at 18, 42, 66 and 90 hpi could be more meaningful that that at 6, 30, 54 and 78 hpi (Fig. 2).

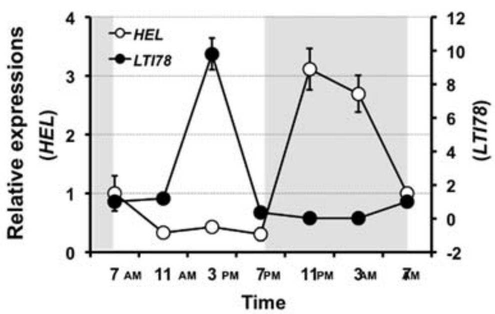
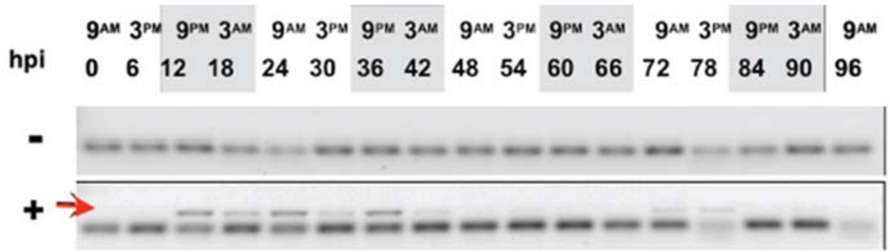


Fig 3. *HEL* and *LTI78* transcripts are both regulated by the circadian clock. qRT-PCR of *HEL* and *LTI78* to *GAPDH* control under di- urnal conditions (12h-light/12-h dark).

Ppc1-indueced transcriptional rearrangement is inter-con- nected with the circadian clock regulatory gene expres- sions. We next investigated whether the rhythmic pattern of *HEL* and *LTI78* expressions persisted after Ppc1 inoculation. Indeed, the levels of *HEL* and *LTI78* expressions induced upon Ppc1 inoculations constantly presented oscillatory patterns (Fig. 4, next page), indicating that interplay between the circa- dian-clock and Ppc1 regulations underlines the mode of action of drought priming. Further studies are needed to better understand the intertwined regulatory mechanisms of plants, and their redundant and specific metabolic pathways by (or towards) multiple environ- mental cues such as drought, circadian clock, light and microbes; these will be critical to, in pursuit of developing a new cultivar conveying drought tolerance and growth enhancement, fine tune energy fitness between growth and stress defense, precisely allocating resource towards two different physiological states to sustainably increase crops yields and productions.

Fig 5. Time resolved semi-qRT PCR analyses of *PR1* upon Ppc1 inoculation. The red arrow indicates the size of *PR1*. Please see the Figure 2 legends for the experimental conditions.



Ppc1 induces *PR1* expression. Our preliminary study exhibited that Ppc1 is capable of stimulating the level expression of *PR1* (*PATHOGNESIS RELATED PROTEIN 1*) transcript (Fig. 5). Thus far, a large number of most, if not all, studies have suggested that the roles of PGPR is related with jasmonate and ethylene signaling pathway, and implied independent mode from salicylic acid (SA) signaling pathway. However, our results with Ppc1-ineduced *PR1* which is a key and evident marker gene of SA signaling could throw a new light on the role of PGPR, relaying its roles in SA signaling and subsequently enhanced disease resistance against biotrophic pathogens such as other pathogenic bacteria and viruses.

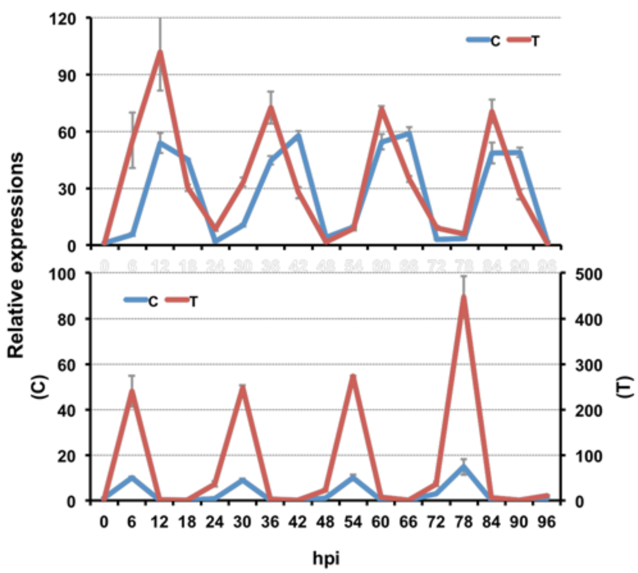


Fig 4. Time resolved high resolution qRT PCR analyses of *HEL* (upper panel) and *LTI789* (lower panel) upon Ppc1 inocu- lation. qRT-PCR of *HEL* and *LTI78* to *GAPDH* control under di- urnal conditions (12h-light/12-h dark). C: control, and T: Ppc1 treated.

Future direction

Together, the plant growth and RNA preparation conditions were determined. Most importantly, our preliminary results defined four experimental time points for subsequent, global gene expression analy- sis (0, 6, 18 and 24 hpi).

Network Modeling of Priming Drought Tolerance in Soybean

S. W. Park and E. Sikora

Objective

Generation of a new genetic repertoire in the development of GM soybean lines conferring enhanced drought resistance. The proposed study will employ systema biological approach to discern and characterize a set of genes which is **a**) essential in plant tolerance to and/or assimilation of water shortage, and also **b**) regulated (i.e., up- or downregulated) by Ppc1. Systems biology yields models that analyze various changes in biological systems over time and seeks to uncover the predictable and unpredictable intricacies of many different causal relations within diverse biological components. Any given genotype has a sophisticated underlying network of macromolecular interactions that give rise to phenotype. Network biology, a branch of systems biology, translates the complexities of molecular interactions into a biological message. Typically in a network, physical and functional interactions between molecules are referred to as edges, and the molecules involved in the interactions are termed nodes. Nodes can correspond to nucleic acids, proteins, hormones, metabolites, or other macromolecules. The functional understanding of network structure and dynamics is vital to expanding our knowledge of how the intercellular communication processes are executed. Collectively, network analysis can generate models to **a**) elucidate the structural and functional architecture of a plant cell during stress perception, **b**) infer and assess biological functions in plant stress resolution, **c**) under- stand biological processes and molecular pathways in plant-microbe interactions, and **d**) predict and pri- oritize candidate protein(s) for further investigation.

Procedure

We will prepare time-resolved mRNA samples (0, 6, 18 and 24 hpi) upon the application of Ppc1 or nega-tive control bacteria such as *Bacillus megaterium* (~36 samples; control and two (total three) bacterial applications, three biological replications, and four time points). DNA array will be performed with microchips probing > 29,110 plant genes at the Microarrays Inc. (Huntsville, AL; If needed, RNA sequencing will be carried out instead of the DNA chip analysis). The resulting 'cdna' data files will be then computationally analyzed, and gene probes will be identified on the basis of TAIR (plant genome database) version 7; the ID will annotate as TAIR ID, gene symbol and description, chromosome coordinates, RefSeq cross-reference, and gene ontology terms.

Proposed budget

Graduate Student (6 mo)	$ 9,364.00
RNA preparation kit	$ 5,630.00
DNA Microarray ($ 125 X 36)	$ 6,750.00

Total funds requested: $21,744.00